MOLD AND MOISTURE PROBLEMS IN NATIVE AMERICAN HOUSING ON TRIBAL LANDS: A REPORT TO CONGRESS

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Mold and Moisture Problems in American Indian and Alaska Native Housing on Tribal Lands: A Report to Congress

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EXECUTIVE SUMMARY

Mandate for the Study

The U.S. Congress determined that providing affordable homes in a safe and healthy environment for the American Indian and Alaska Native (AIAN) population is essential. Congress passed the Native American Housing Assistance and Self-Determination Reauthorization Act of 2002 (NAHASDA) (U.S.C. 4195) and President George W. Bush signed it on November 14, 2002. The NAHASDA Reauthorization Act required the Secretary of Housing and Urban Development to 1) complete a study on the extent of black mold infestation of Native American housing in the United States; and 2) to submit to Congress in 180 days a report that describes the Secretary's recommendations to address the infestation. The Secretary of HUD directed the Office of Native American Programs (ONAP) to complete this Congressional Study.

Scope of the Study

Congress requested a study on black mold infestation of Native American housing. This study goes beyond that scope to cover all types of mold problems in tribal housing. It is evident from preliminary research that black mold is a small part of a larger, more general mold issue which affects housing conditions, living environments, and potentially the health of residents. The study includes in its scope an effort to understand the root cause of mold, which is widely accepted to be moisture problems. While mold and moisture problems impacting human health is a concern in other types of building structures, the scope of this study is limited to addressing conditions in assisted housing on tribal lands. There are currently no data or reports that address the extent or incidence of mold problems in building structures nationwide to indicate whether tribal lands experience a higher incidence of mold problems than the rest of the nation.

Study Approach

Research on the extent of mold in tribal housing involved the following five components:

- Housing unit and demographic data

The number of housing units was obtained from the Indian Housing Block Grant Program Formula (IHBG) database. It is based on the number of Low Rent (LR), Mutual Help (MH), and Turnkey III (TK) units currently under management by tribes or Tribally Designated Housing Entities (TDHE). Units that are privately owned, sponsored by the Bureau of Indian Affairs (BIA), and new units constructed under NAHASDA were excluded from this count. Demographic data on AIAN populations, including household figures, is from the 2000 U.S. Census.

- Data on reported mold problems

The six ONAP Area Offices were canvassed to determine the number of LR, MH, and TK units for which residents or tribal housing officials had reported mold problems. The number of units with reported mold problems was compared with the total number of LR, MH, and TK units for each tribe. The results were used to estimate the total number of LR, MH, and TK units with reported mold problems for all six ONAP Area Office jurisdictions.

- Site visit information

Inspectors trained in assessing mold problems visited 21 reservations nationwide that had reported mold problems. They prepared reports of those visits and summarized the results in data entered into a database. Digital photos were taken to document pertinent findings. Some of these photos are in Chapter 4. Moisture related physical measurements, such as humidity and airflow, were also taken. Technical assistance sessions with Tribally Designated Housing Entity (TDHE) staff members, as well as discussions with residents and administrators provided additional insight into the mold and moisture problem.

- Cost estimates

While the full cost impact of remediating mold is difficult to determine, this study looks at some potential remediation and training costs. Preliminary estimates of costs for remediating and preventing mold and moisture problems in existing housing were made. These estimates address the physical remediaton costs as well as training and education costs for tribal housing authorities to build the capacity of tribal staff to identify and prevent mold, repair moisture conditions, and rehabilitate homes. More importantly, efforts are made to identify means of incorporating information gleaned about mold into currently funded work.

- Literature review

A review of current literature on mold and moisture in housing, including identification, prevention, and remediation of mold and the impact of mold on human health was also completed.

Findings

This study presents eight major findings on the mold problem in tribal/TDHE housing:

1. **No definitive evidence that inhaled mold toxins have generally adversely affected human health.**

The current body of scientific knowledge regarding the health effects of mold provides no definitive evidence that inhaled mold toxins in home, school, or office have generally adversely affected human health. The health effects of inhaled mycotoxins are currently controversial in the scientific and health communities. Mold has been shown to be a health risk to the following susceptible populations: the very young; the elderly; those with existing respiratory problems, such as asthmatics; and the immunocompromised, such as AIDS patients and those who are undergoing chemotherapy (Indian Health Service, Position Paper on Mold, 2003). Chapter 2 provides further explanation of this finding.

2. **Mold conditions estimated in 15 percent of housing units.**

During a six-week period, all six of the ONAP Area Offices contacted their respective tribes/TDHEs to collect information on the number of tribes that had reported mold problems. Twenty percent of the tribes, representing 43,532 housing units (65 percent) of the total units currently under management, responded to the canvassing efforts of the six ONAP Area Offices. Canvassing results found that 6,743 units (15 percent) had reported mold conditions. (The housing units canvassed excluded those that are privately or tribally owned, sponsored by the Bureau of Indian Affairs, or newly constructed under NAHASDA). If the same rate of reported mold problems were applied to the total number of assisted housing units currently under management of tribes/TDHEs, 9,529 units are estimated to have reported mold problems. Detailed information about this finding is found in Chapter 5.

3. **Mold and moisture problems are commonly caused by physical conditions that can be categorized into nine areas.**

Based on the visits to 21 reservations that had reported mold problems, the research team identified the most common types of mold and moisture problems: 1) site drainage, 2) gutter systems, 3) leaks from the exterior, 4) wet basements or crawl spaces, 5) plumbing, 6) bathrooms, 7) exhaust ventilation, 8) exterior walls or ceilings, 9) and attic. Chapter 6 provides an in-depth discussion on these problem categories.

4. **There are four root causes that result in moisture problems, and these root causes define the points of intervention for developing long-term solutions.**

The root causes of moisture problems and subsequent mold contamination are:

i. Design and construction issues – moisture conditions that result from original design decisions, detailing, and construction execution.
ii. TDHE maintenance – moisture conditions that result from lack of maintenance on larger items that typically are the responsibility of the housing authority.

iii. Occupant maintenance and practices – moisture conditions that result from lack of maintenance on smaller items that are typically the responsibility of the occupants. Occupant practices can also impact moisture load.
iv. Overcrowding and low-income issues – moisture conditions that arise from high density of occupants and other low-income impacts

Actions to address long-term mold and moisture problems emerge from these root causes, and center on training, technical assistance, and supplemental resources to develop local capacity aimed at improving housing design and maintenance at both the staff and resident levels. A full description of this finding is in Chapter 6.

5. Overcrowding is a factor in mold and moisture conditions.

Overcrowded housing increases the risk of mold and moisture problems. Overcrowding multiplies the generation of moisture from human sources, which contributes to elevated interior moisture loads, and ultimately (if other conditions are in place) can lead to mold contamination from condensation. Overcrowding contributes to rapid deterioration of housing materials and equipment, which can also lead to moisture problems and mold. Overcrowding increases storage problems. With more personal possessions inside the house, closets are overfilled and objects are likely to be placed against exterior walls creating cold spots for condensation and contributing to mold. Further discussion about this finding is in Chapter 6.

6. Self-reports of mold are reliable indicators of actual mold and moisture problems.

Inspection teams trained in mold identification and remediation visited 21 tribes to confirm and document the extent of mold problems in units where residents reported mold problems. These inspection teams investigated 175 units, most of which had resident-reported mold problems. Of these 175 inspected units, 62 percent had visible mold and 85 percent had identifiable moisture problems, confirming that resident-reports of mold are very reliable indicators for mold and moisture problems. A full description of this finding is in Chapter 7.

7. Wide range of concern, knowledge, and programmatic approaches.

The site visits illustrated considerable variability regarding all aspects of the mold problem. The inspection teams found varied levels of concern among residents and TDHE staff about mold in homes, ranging from very little interest (not addressing visible mold problems) to extremely high concern (relocation of households and extensive testing for mold). The knowledge and experience in addressing mold problems also showed significant variability among the TDHEs. As would be expected, the management, resident services, educational, and maintenance programs addressing mold problems were also diverse. Maintenance programs, in particular, showed a wide range of

effectiveness in dealing with mold and moisture problems. Further explanation of this finding is found in Chapter 7.

8. Remediation and training are needed to support tribal/TDHE remediation and prevention efforts.

This study includes a cost estimate to determine the one time amount that would be necessary to address the mold and moisture problem in the impacted units. The preliminary estimate for the remediation of mold and moisture problems (time and material) is $77.3 million. This figure represents the estimated cost for trained, experienced remediation crews to remove and clean mold and correct the underlying cause of the moisture problem. To complement the physical remediation efforts, training for tribes/TDHEs are needed to strengthen their capacity to develop and implement effective assessment, maintenance, remediation, and educational programs to address mold and moisture conditions. The preliminary cost estimate for a comprehensive Mold Training and Education Program is $13.4 million annually for a three year period. The total preliminary cost estimate for remediation and a tribal training program is $90.7 million.

Recommendations

The following recommendations address some of the opportunities related to mold and moisture problem prevention and remediation in tribal/TDHE housing.

1. Develop a short-term strategy for existing mold problems and a long-term strategy for the prevention and treatment of future problems.

A short-term strategy is required to provide resources for addressing existing moisture and mold problems, primarily focused on current physical conditions in housing. Preliminary cost analysis conducted as a part of this study estimates that $77.3 million is needed to remediate the existing mold and moisture problem in AIAN tribal/TDHE housing. Tribal housing professionals have reported mold remediation costs could be as high as $25,000 per unit in some cases, with the amount dependent upon the conditions and the sources of the mold-and-moisture problems. A long-term strategy should be developed to address the root causes of mold and moisture problems. Such a long-term strategy will only be successful when fully implemented at the local level. The goal of this strategy could be to develop the capacity of the local TDHEs to prevent moisture problems and promptly mitigate problems when they arise. A preliminary cost analysis of such a program revealed forecasts that an annual allocation of $13.4 million for three years is may be needed to implement a comprehensive Mold Training and Education program. The combined preliminary estimate for both remediation and training is $90.7 million. However, additional research and analysis would provide a more accurate cost estimate of the actual program needs.

An initiative that addresses both short-term and long-term needs could include:

- A program of continuing on-site technical assistance
- On-site training programs focused on assessment and remediation
- Development of housing management and resident education programs

Due to the cultural, social, economic, and geographic diversity of AIAN tribal communities, a flexible program that allows tribes diverse options to address their specific needs is needed to ensure successful prevention and remediation of mold and moisture problems.

2. Enhance site visit research and database.

The 21 site visits to tribes with reported mold problems provided technical assistance and on-site skills building to tribe/TDHE staff and tribal housing residents. The site visits enabled the research team to collect valuable information and develop a database reflecting the characteristics, extent, and physical conditions leading to mold and moisture problems in tribal housing. There is much yet to be learned about the extent and parameters of the mold problem. A program of well-designed and integrated research studies could provide a more thorough understanding of the characteristics of the problem and the optimal approaches to address it. Enhancements to the methodology and data collection efforts could create an expanded dataset for further analysis, potentially providing insight into programmatic correlations relating to the mold problem. Additional site visits to tribes with reported mold problems are also needed to address the increased demand by the tribes and to gather additional data, train tribal/TDHE housing staff to conduct assessments for mold and serve as a support to the training and education program.

3. Investigate the creation of a national housing design clearinghouse.

To enhance planning and design of new housing, housing design resources could be provided through a national housing design clearinghouse. This national clearinghouse could help avert the cycle of moisture problems that result from poor design and site selection. Through the national clearinghouse, information and technical expertise would be available to build tribes' capacity for tasks such as reviewing plans for site design and grading, mechanical and ventilation systems, and building envelope. Tribal members and TDHE staff would be trained to prevent mold and moisture problems, through proper installation of ventilation and mechanical systems, for example. The research team has had preliminary discussions with both Indian Health Service (IHS) and the Federal Emergency Management Agency (FEMA) about the benefits of coordinating site design and plan checks and land use plans as a prevention measure against mold and moisture problems in AIAN tribal/TDHE housing.

4. Partner with Federal, state, and local agencies and organizations.

Tribal governments and TDHEs could collaborate with Federal agencies to form strategies to resolve mold and moisture conditions. For example, collaboration with the Federal Emergency Management Agency (FEMA) might address site design and drainage (one of the most common problem categories), since FEMA is mapping flood plain areas on the reservations. This information can be invaluable in site selection decisions, preventing building in flood-prone areas. High water tables and flooding have been identified as contributing to mold conditions on some tribal lands. Partnering with Indian Health Service, Centers for Disease Control and Prevention, and the Environmental Protection Agency could help address health, environmental and indoor air quality issues related to mold and moisture conditions. Collaboration with the Bureau of Indian Affairs and Rural United State Department of Agricultural housing programs could provide additional resources for housing repairs, remediation, and new construction.

Organization of the Report

This Congressional report is organized in nine chapters. Chapter 1 provides an overview of the problem and describes the controversy surrounding black mold. Chapter 2 presents some of the basic health issues related to mold from a review of the most current scientific and health literature. Chapter 3 is an overview of selected demographic characteristics of the AIAN population and housing data from the 2000 U.S. Census. Chapter 4 outlines HUD housing programs for the AIAN population. Chapter 5 describes the extent of reported mold problems in tribal housing, based on canvassing six ONAP Area Office jurisdictions. Detailed descriptions of building and site problems that contribute to the root causes of mold utilizing examples from the 21 site visits to tribes with reported mold problems are included in Chapter 6. Chapter 7 describes the methodology of the 21 site visits to tribes with reported mold problems and includes a summary of a site visit conducted in each ONAP Area Office jurisdiction. Chapter 8 describes cost estimates for remediation of mold and moisture conditions by problem category. Finally, a discussion of the findings and recommendations of the study is in Chapter 9.

CHAPTER 1: INTRODUCTION

Tribes/TDHEs throughout the United States report mold and moisture problems. Many tribal governments and TDHEs are struggling to identify, remediate, and solve these problems. In some cases, these struggles have significant financial and social costs, including the abandonment and demolition of housing and relocation of families. The Office of Native American Programs, HUD is committed to ensuring that residents of tribal housing live in safe, well-maintained housing units. Providing healthy home environments for all AIAN households on tribal lands is a major priority for the Federal government and tribal governments.

This report examines the issue of mold and moisture problems in tribal/TDHE housing. The material in this report is based on a number of sources; most prominently from site visits to 21 tribes with reported mold problems. Over 170 residences were inspected for mold and moisture conditions. Discussions and technical assistance sessions with residents, tribal administrators, and TDHE staff during these visits provided key insights. Additionally, an examination of the current scientific and health literature regarding mold was performed.

"Black mold" a name that often refers to the mold *Stachybotrys chartarum,* has been presented in the national media and elsewhere as a toxic threat to humans. Surveys of the scientific and health literature however, show that the perception of danger from mold in general and this species in particular is unwarranted for most people. The American College of Occupational and Environmental Medicine recently concluded, "Current scientific evidence does not support the proposition that human health has been adversely affected by inhaled mycotoxins in home, school, or office environments" (American College of Occupational and Environmental Medicine, "Adverse Human Health Effects Associated with Molds in the Indoor Environment," http://www.acoem.org/guidelines/pdf/Mold-10-27-02.pdf, accessed on 5/1/03).

Although there is no agreement in the scientific and medical communities on the effects of "black mold" on human health, there is consensus that mold can be a factor in various health problems. People with respiratory illnesses, such as allergies and asthma, tend to be most sensitive to indoor mold. Typical reactions to mold include allergic reactions, asthma attacks, and minor irritant effects. According to the U.S. Environmental Protection Agency (EPA), type and severity of symptoms depend, in part, on the types of mold present, the extent of the individual's exposure, and existing sensitivities or allergies (EPA, "Mold Remediation in Schools and Commercial Buildings," 2001).

In certain areas of the country and specific communities, media attention and high profile litigation have had an effect on public perception regarding indoor mold. In these areas, occupants' perceptions of the health problems caused by mold may be disproportionate to actual conditions. Common misperceptions about mold complicate efforts toward designing and implementing cost-effective solutions. See Appendix B for an article clarifying common misperceptions about mold . Successful resolution of mold problems requires addressing both the actual problems and their perception. Chapter 2 examines

the known health effects of mold and the current status of medical research and public perception.

While indoor mold contamination has received considerable media attention, there has been no comprehensive national survey that indicates the prevalence of mold in residences. It is clear that mold problems can develop in any residence with excess moisture, regardless of class or income level. At this time, there is no data to support the belief that the mold problem is greater in tribal/TDHE housing than the housing of the population of similar economic status. However, the isolated rural location, severe climate conditions, housing shortages, overcrowded housing conditions typical of tribal/TDHE housing are all factors that contribute to their mold and moisture problems. Chapter 3 provides an overview of AIAN demographic and housing data, particularly as it relates to poverty. Chapter 4 provides a background on HUD's tribal/TDHE housing programs. Chapter 5 presents an estimate of the extent of the mold problem based on a canvassing of TDHEs by HUD's ONAP Area Offices.

More than 100,000 species of mold exist; at least 1,000 species are common in the United States. Mold grows on organic materials and requires an elevated moisture level to sustain life. For this reason, mold problems are properly corrected by eliminating the sources of excess moisture. Mold can grow on virtually any substance when moisture is present, including wood, paper, carpet, and food. At a minimum, mold is a nuisance, and a clear indicator of unhealthy levels of moisture in a residence.

Sites of active mold growth should be corrected, first by identifying and correcting the underlying moisture problem, and then by safe and effective cleaning or removal of the affected surfaces. The moisture conditions that lead to mold may, if allowed to persist, lead to growth of fungi, which can do structural damage to wood-frame buildings. The moisture conditions that lead to mold are well known, preventable, and repairable. Mold conditions in homes can generally be cleaned and remedied. Chapter 6 presents the specific building and site problems (plumbing, roof leaks, etc.) that lead to mold contamination. This chapter also examines the root causes that contribute to building and site problems. The root causes (design defects, deferred maintenance, etc.) can also be considered as the points of intervention that can effectively address the problem in tribal/TDHE housing.

A summary of the 21 site visits to tribes with reported mold problems is provided in Chapter 7. The methodology, along with a sampling of results from each of the six ONAP Area Office jurisdictions, is presented. The site visits provided a platform for observing the levels of experience, knowledge, and concern in dealing with mold problems among various tribes/TDHEs. A wide range of experience and levels of concern was found during these site visits. Additionally, the site visits indicated a wide range of emphasis with regard to maintaining existing housing, a critical component in addressing mold and moisture problems.

Mold problems create institutional and financial challenges for tribes/TDHEs regarding problem assessment, mold and moisture remediation, training, equipment, and the overall

allocation of resources. Technical support and training are critical in helping tribes/TDHEs increase their capacity to solve their mold and moisture problems. A flexible program dedicated to increasing the capacity of tribes/TDHEs will be critical. Chapter 8 examines some of the cost estimates associated with meeting the financial challenges involved with remediation of existing mold and moisture problems as well as implementation of a comprehensive prevention and education program aimed at increasing the capacity of tribes/TDHEs to identify and mitigate problems promptly. Chapter 9 presents the general findings and recommendations of the report, which address mold and moisture problems in present and future housing stock on tribal lands.

Mold in tribal/TDHE housing presents numerous social, political, institutional, and financial challenges to tribes and tribal governments. HUD, along with other Federal agencies, is working to address mold and moisture problems in tribal housing. Concerted effort and investment by tribal, Federal government and non-governmental entities are needed to address these problems effectively.

A number of appendices are provided with the report. References for this report are included in Appendix A. Basic facts demystifying common misperceptions about mold, mold testing and remediation are included in Appendix B. The Indian Health Services Position Paper on Mold is provided in Appendix C. Appendix D contains a discussion of the difficulties and potential for errors with mold sampling. A brief listing of programs and resources addressing mold and moisture problems by Federal agencies and other nongovernmental entities is in Appendix E.

CHAPTER 2: HEALTH ISSUES RELATED TO MOLD

Background

Public concern about "black mold" was heightened due in part to a paper published by the Centers for Disease Control in 1994. This paper, titled "Acute pulmonary hemorrhage/hemosiderosis among infants—Cleveland, January 1993–November 1994." explored the hypothesis that exposure to one mold species, *Stachybotrys chartarum*, may have been responsible for several cases of acute idiopathic pulmonary hemosiderosis (AIPH), leading to the deaths of several infants. This paper triggered sharp interest in the potential health effects of mold among those in the health field, the media, environmental consultants, and attorneys. However, in March 2000, the CDC rescinded the findings of the 1994 Cleveland paper [CDC, MMWR 49(09); 180-4 Update: Pulmonary Hemorrhage/Hemosiderosis Among Infants—Cleveland, Ohio, 1993–1996]. This 2000 paper concluded that the evidence from these studies was not of sufficient quality to support an association between *Stachybotrys chartarum* and AIPH owing to the following limitations: 1) the reported odds ratio was statistically unstable and potentially inflated, and 2) the investigator oversampled case homes. Although some molds produce mycotoxins, the toxic compounds secreted by molds that can cause illness (see Appendix D), there is no scientific evidence that this mold type is more harmful than others.

Furthermore, a similar CDC study (unpublished) of seven pulmonary hemorrhage cases in Chicago from 1992 to 1995 did not detect *Stachybotrys chartarum* in any of the case homes, but identified mold in 35 percent of control homes. The Chicago study found a different fungus, *Trichoderma*, in significantly more case homes than control homes. The Chicago study formed no conclusions on either mold causing health problems. The CDC reviewers concluded that the evidence from these studies does not support an association between *Stachybotrys chartarum* and pulmonary hemorrhaging (idiopathic pulmonary hemosiderosis).

Surveys of Current Scientific and Health Literature

As stated in the Introduction, surveys of the current scientific and health literature show that the perception of danger from mold in general and this species in particular is unwarranted for most people. In "Adverse Human Health Effects Associated With Molds in the Indoor Environment" (2002), the American College of Occupational and Environmental Medicine recognized the importance of studying mold related health issues and concluded:

1. Fungal allergies are common. There is sufficient evidence of an association between exposure to mold and exacerbations of asthma, but there is currently no direct evidence that mold causes people to become asthmatic.

2. Serious infections from mold are a concern for individuals with severely compromised immune systems.

3. To date, no study in humans has conclusively linked mycotoxin inhalation exposure to serious health effects.

The Indian Health Service (IHS) Division of Environmental Health Services recently published its "Position Statement" on mold, which is in Appendix C. The point of view in the paper is consistent with the consensus view above.

The IHS Division of Environmental Health Services (DEHS) assumes responsibility for responding to mold complaints in tribal communities. It recommends using a team of stakeholders and technical experts and discourages sampling the air in housing units for mold. The most important step to eliminate mold is to eliminate excessive moisture, the department states.

A mold complaint is likely to be a complaint of poor health, usually chronic respiratory health, for a family member that occupies a home with visible mold. It is rare in such a case for a clinician or housing official to make a determination of mold as the cause of the disorder. Occasionally, individuals find their condition improves outside the house and degrades when staying in the house. In this case, it may make sense to assign the indoor environment as a major factor.

> Mold spores are present in all indoor environments and cannot be eliminated from them. Normal building materials and furnishings provide ample nutrition for many species of molds, but they can grow and amplify indoors only when there is an adequate supply of water. Where mold grows indoors there is an inappropriate source of water that must be 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 environments.
>
> American College of Occupational and Environmental Medicine "Adverse Human Health Effects Associated with Molds in the Indoor Environment" (2002)

However, while mold is a possible factor, it is usually not the most prominent factor. The team approach by DEHS should make a strong contribution to addressing the needs of affected individuals.

This is not to dismiss the widespread concerns about the potential health effects of mold. However, regardless of the relationship between mold and illnesses, the mold problem should be addressed for several reasons:

- Mold is linked to allergic reactions in many individuals, particularly asthmatics.
- Mold is a nuisance. It is unsightly and may produce unwelcome odors, so active growing mold should be eliminated from buildings.
- Mold grows where moisture problems occur. Mold can be an incentive to correct moisture problems that may lead to problems of corrosion, material degradation, and structural weakening.

- Avoidance of mold growth is one characteristic of quality construction, and it deserves to continue to serve as a quality criterion.

Dampness as a Health Problem

There have been efforts to describe humidity in homes scientifically. From the building science literature, Tsongas (1993) has compiled a list of the most prominent case studies of moisture problems in residences. The report *Clearing the Air: Asthma and Indoor Exposures* by the National Academy of Science/Institute of Medicine (2000) presents a thorough discussion of dampness and its relation to asthma. From these studies, only a vague picture emerges of the distribution of wetness and dryness in houses. There has never been a thorough survey that might offer a baseline of how wet or dry U.S. houses actually are. Reasons for this lack of information include:

- There is no standard protocol for characterizing the wetness or dryness of homes. Results are not comparable among studies.

- Many of the studies are follow-ups to occupant complaints of moisture. Thus they cannot be used to document the distribution of moisture problems in the general population.

- There is no set standard for the best humidity level in homes.

The public health literature contains studies using a variety of protocols, but moisture conditions are typically taken only as a small set of environmental conditions. Brunekreef et al (1990) presented a detailed moisture checklist system from Holland, in use since the 1960s, which requires thorough inspection and provides a numeric score. Woods, et al, (1989) presented a method for protocol development that involved three phases: 1) consultation, where a preliminary hypothesis is formulated, 2) qualitative diagnostics, where the hypotheses are tested to compile a list of factors, and 3) quantitative diagnostics, where conclusions are validated. In the characterization presented in Wood et al, the diagnostic procedure is customized not only from study to study, but from sample to sample. This is appropriate when the aim is diagnosis, but it disallows the results for any comparative or population studies.

The *Clearing the Air* report by the Institute of Medicine showed that dampness in buildings has a stronger correlation with asthma and respiratory problems than does mold. Thus any effort to reduce moisture problems in buildings, prompted in this case by mold, should produce positive health outcomes.

While the current body of scientific knowledge regarding the health effects of mold suggests that the presence of mold in buildings constitutes a minimal health risk to the general population, it is important that HUD and other Federal agencies continue to support and monitor new research about the health impacts of mold that may become available in the near future. By staying current on the research, HUD can continue to

respond appropriately to mold problems in tribal housing and provide safe and healthy living environments for residents.

CHAPTER 3: OVERVIEW OF AMERICAN INDIAN AND ALASKA NATIVE DEMOGRAPHIC, HOUSING, AND CLIMATE DATA

American Indian and Alaskan Native (AIAN) communities are culturally, socially, economically, and geographically diverse. Most reservations and trust lands are located in isolated rural areas and in regions with extreme climatic conditions. Despite the U.S. Government's special obligation to the AIAN people and their resulting efforts to provide support to the AIAN population and ensure their well being, AIAN income levels, housing conditions, and affordable housing stock on tribal lands significantly lag behind the general U.S. population.

To provide a context for this study, this demographic profile offers background information on the AIAN population, specifically their income levels and housing conditions and the climatic conditions of tribal lands.

American Indian and Alaska Native Demographic Data

Population

The U. S. Census has documented the AIAN population trends from 1900 to 2000.

Table 1
American Indian and Alaska Native Population (Alone) 1900 – 2000

Census Year	Population (AIAN alone)
1900	237,196
1910	265,583
1920	244,437
1930	332,397
1940	333,969
1950	343,410
1960	523,591
1970	792,730
1980	1,420,400
1990	1,959,234
2000	2,475,956

Source: US Census 2000

There are 2,475,956 AIAN (alone) and 4,094,419 AIAN combined population (AIAN and other racial categories). The AIAN population has grown significantly over the last 40 years. For example, from 1990 to 2000, the AIAN (alone) population grew by a reported 26 percent. By comparison, the total U.S. population growth from 1990 to 2000 was 13.2 percent. Table 2 outlines growth trends by decades from 1960 through 2000.

Table 2
American Indian and Alaska Native Population Growth 1960 – 2000

Decades	Population (AIAN alone)	Percent Increase
1960–1970	523,591–792,730	51.4 %
1970–1980	792,730–1,420,400	79.2 %
1980–1990	1,420,400–1,959,234	37.9 %
1990–2000	1,959,234–2,475,956	26.4 %

Source: US Census 2000

Poverty Levels

The AIAN (alone) population has the highest poverty level, at 25.7 percent, of any group in the United States. Table 3 outlines 1999 poverty levels nationwide.

Table 3

Household Incomes Below Poverty, 1999

Race/Group	Percentage
White (alone)	9.10 %
Asian (alone)	12.60 %
Native Hawaiian/Other Pacific Islander (alone)	17.70 %
Hispanic or Latino (any race)	22.60 %
Black or African American (alone)	24.90 %
American Indian/Alaska Native (alone)	**25.70 %**

Source: U.S. Census 2000

Income

The AIAN (alone) median household income is reported at $30,599, the second lowest level of median household income among all groups.

Table 4
Median Household Income

Race/Group	Income in US Dollars
Asian (alone)	$51,908
White (alone)	$44,687
Native Hawaiian/Other Pacific Islander (alone)	$42,717
Hispanic or Latino (any race)	$33,676
American Indian and Alaska Native (alone)	**$30,599**
Black or African American (alone)	$29,423

Source: U.S. Census 2000

Housing Data

Overcrowding

According to the U.S. Census, overcrowding was defined as more than 1.01 person per room in 1990. Based on this criterion, 32.5 percent of households on American Indian Reservations and Trustlands (excluding Alaska) were overcrowded and 40.4 percent of households in Alaska Native Village Areas were overcrowded in 1990. In comparison, only 4.9 percent of households were overcrowded in the United States as a whole in 1990.

Overcrowding in residential units has been a longstanding problem in tribal/Tribally Designated Housing Entities (TDHE) housing. A shortage of housing, combined with limited household resources, has resulted in overcrowding in Native American housing. The Native American culture emphasizes a commitment to the health and welfare of each other. Native Americans often feel obligated to house extended families or neighbors when economic struggles or disasters result in loss of housing. Two recently prepared reports—*Too Few Rooms Residential Crowding in Native American Communities and Alaska Native Villages* published by the National American Indian Housing Council (2001) and *A Quiet Crisis, Federal Funding and Unmet Needs in Indian Country* (2003) published by the U.S. Commission on Civil Rights, discuss overcrowding on reservations and its impact on the AIAN population. In *A Quiet Crisis*, the authors write:

> It is not uncommon in Native communities for 25 to 30 people to share a single home. Crowding on Indian trust lands is six times the national rate, and in Alaskan Native villages it is eight times the rate. In fact, more than a third of homes on reservations and more than 40 percent of homes in Alaska Native Villages are overcrowded, compared with roughly 5 percent of the homes in the United States. The true extent of overcrowding may, in fact, be underestimated because no extensive studies have been done, and

no federal agency has a comprehensive database that includes all reservation housing units and number of occupants (pg. 66).

Median Value of Homes

The AIAN population has the second lowest median home value, $81,000, compared with other U.S. population groups. There is a 1 percent difference from the lowest reported group.

Table 5
Median Value of Homes

Race/Group	Value in U.S. Dollars
Asian (alone)	$199,300
Native Hawaiian/Other Pacific Islander (alone)	$160,500
White (alone)	$122,800
Hispanic or Latino (any race)	$105,600
American Indian and Alaska Native (alone)	**$81,000**
Black or African American (alone)	$80,600

Source: U.S. Census 2000

Households Lacking Complete Plumbing

The AIAN population has the highest percentage of households without adequate plumbing, 4.4 percent compared with other U.S. groups.

Table 6
Percent of Households Lacking Complete Plumbing Facilities

Race/Group	Percentage
American Indian and Alaska Native (alone)	**4.40 %**
Hispanic or Latino (any race)	1.50 %
Native Hawaiian/Other Pacific Islander (alone)	1.40 %
Black or African American (alone)	1.10 %
Asian (alone)	0.90 %
White (alone)	0.50 %

Source: U.S. Census 2000

Households Lacking Complete Kitchen Facilities

The AIAN population has the highest percentage of households without adequate kitchen facilities, 4.0 percent compared with other U.S. groups.

Table 7
Percent of Households Lacking Complete Kitchen Facilities

Race/Group	Percentage
American Indian and Alaska Native (alone)	**4.00 %**
Native Hawaiian/Other Pacific Islander (alone)	1.40 %
Hispanic or Latino (any race)	1.30 %
Asian (alone)	1.00 %
Black or African American (alone)	0.90 %
White (alone)	0.50 %

Source: U.S. Census 2000

American Indian and Alaska Native Demographic Data Summary

The following summarizes the demographic data for AIANs compared with other groups:

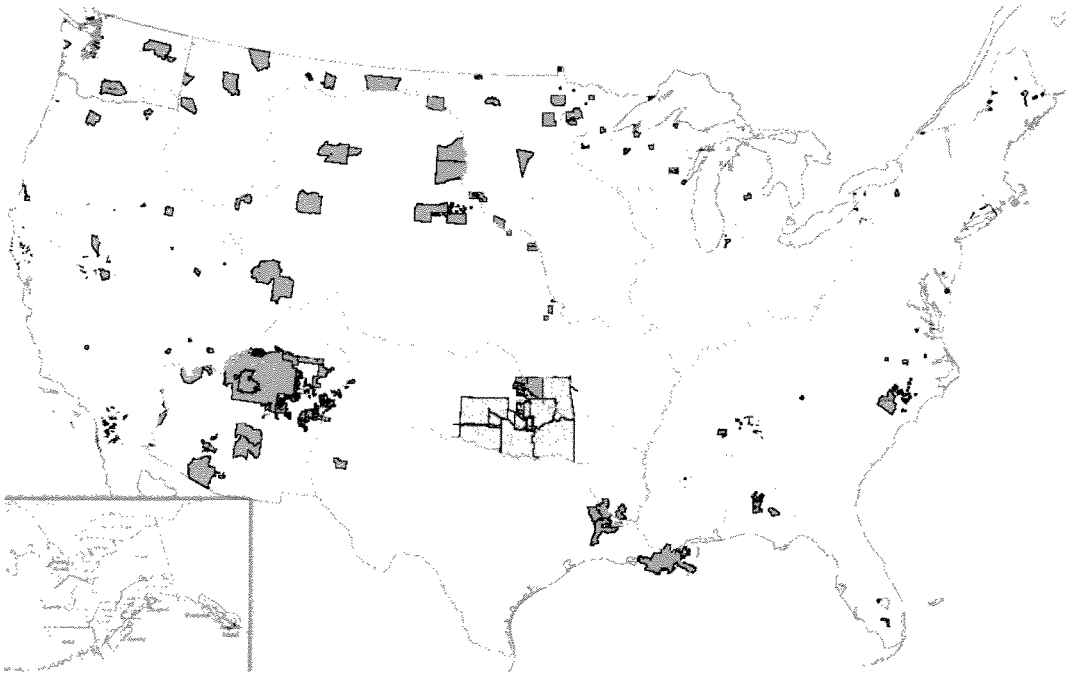
- The AIAN (alone) population has grown 26 percent from 1900 to 2000, from just under 238,000 in 1900 to almost 2.5 million in 2000;
- The AIAN (alone) population has the highest poverty rate at 25.7 percent;
- The AIAN (alone) median household income is second lowest at $30,599;
- The AIAN population is more likely than any other racial or ethnic groups to live in substandard or overcrowded housing (in 1990, AIAN households were more than six times more likely to be overcrowded than the average U.S. household);
- The AIAN population has the second lowest median home value at $81,000;
- AIAN households have the highest proportion of households without adequate plumbing at 4.4 percent;
- AIAN households have the highest proportion of households without adequate kitchen facilities at 4 percent.

U.S. Census data alone cannot fully express the thoughts and feelings of the people. These socioeconomic disparities are critical to the consideration of any housing problem. Therefore, any proposed solution to the mold problems in AIAN areas must address socioeconomic conditions.

Location and Climate of Tribal Lands

Tribal lands are located in varied and diverse regions throughout the continental United States and Alaska. These regions encompass a wide range of climatic and site conditions. Many tribal reservations are located on land with high water tables and in flood prone areas. The map below identifies the locations of tribal lands nationwide (Figure 1).

Figure 1
Map of American Indian and Alaska Native Tribes



The continental United States has an extremely wide range of temperature and moisture conditions as illustrated by the following two maps showing the average annual precipitation and temperature (Figures 2 and 3). The conditions under which mold grows are affected by temperature and moisture. A comparison of the locations of tribal lands with climatic conditions highlights the extreme variations in conditions. The average annual temperature map highlights the cooler temperatures at the northern tier. Many of the tribal lands are located in the northern tier of the United States. These locations are more prone to interior condensation problems. Many Alaska Natives also encounter extreme cold in winter and high levels of snowfall and other precipitation. Site visits revealed that many other factors contribute to mold and moisture problems, such as level of maintenance, economic issues and overcrowding.

Figure 2
Average Annual Precipitation
Continental United States

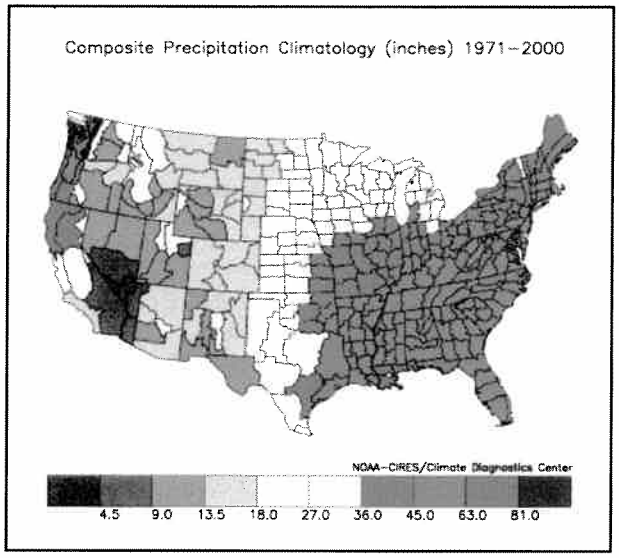
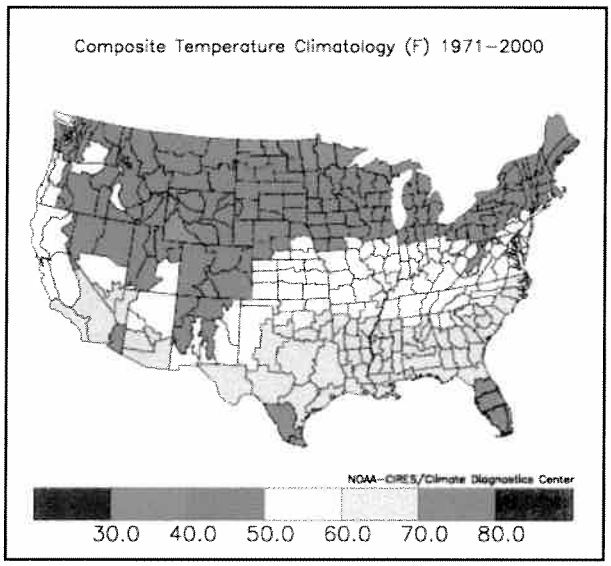


Figure 3
Average Annual Temperature,
Continental United States



CHAPTER 4: OVERVIEW OF HUD AMERICAN INDIAN AND ALASKA NATIVE HOUSING PROGRAMS

The U.S. Department of Housing and Urban Development's (HUD) Indian Housing Programs have evolved since the early 1960s, from a public housing program to more independent status as a result of the 1996 Native American Housing Assistance and Self-Determination Act (NAHASDA) and the creation of the Indian Housing Block Grant Program (IHBG). Currently 542 tribes participate in the IHBG Program nationwide.

HUD administers Indian Housing Programs through the Office of Native American Programs (ONAP). The mission of ONAP is to administer financial assistance for the development and management of low-income housing and community development in AIAN areas. ONAP headquarters is in Washington D.C. and its program office is in Denver, CO. In 1980, six area offices were established at the request of Congress and the AIAN constituency. These are in Anchorage, Chicago, Denver, Oklahoma City, Phoenix, and Seattle.

Tribal governments or Tribally Designated Housing Entities (TDHEs) are responsible for operating, maintaining, and developing housing in tribal communities. The following are descriptions of HUD's assisted housing programs that tribes/TDHEs were eligible for prior to Oct. 1, 1997:

Low Rent Program

The Low Rent Housing Program is the basic low-rent public housing program established by the U. S. Housing Act of 1937. The program became available to American Indians and Alaska Natives in 1961. HUD funds went to Indian housing authorities (IHA) to build new housing units or acquire and rehabilitate existing units for rent by low-income families. The IHA managed the properties and received HUD funds to cover the difference between allowable operating costs and tenant rental payments.

Mutual Help Program

The Mutual Help Homeownership Opportunity Program became available to American Indians and Alaska Natives in 1962. The purpose is to provide homeownership opportunities for lower-income families by purchasing decent, affordable housing. The IHA managed the properties; purchases were not subsidized. An administrative charge to the homebuyers was used to operate the program. Subsidies were provided for homebuyer counseling, vacant unit repair, training, and collection losses.

Turnkey III Program

The Turnkey III Program became available to American Indians and Alaska Natives in the early 1970s. The purpose of the program was to provide homeownership opportunities for lower-income families. This program built 2,300 units. The IHA managed the properties and received parallel construction HUD funds to cover the

difference between allowable operating costs and occupants' Turnkey III payments, which were applied to homeownership.

According to the *1996 Assessment of American Indian Housing Needs and Programs: Final Report,* these programs have had a significant impact on the provision of housing in tribal areas since the early 1960s. Under HUD's Low Rent and Mutual Help housing programs, more than 100,000 units had either been completed or were in production at the end of fiscal year 1997. In fiscal year 1998, 41 percent of the units were Low Rent, 58 percent were Mutual Help, and one percent were Turnkey III. The Mutual Help Program was very popular because of the strong preference for homeownership. Table 8 illustrates the number of units under management of the ONAP Area Offices in fiscal year 1998.

Table 8
Units Under Management, FY 1998

Area Office	Low Rent	Mutual Help	Turnkey III	Total
Alaska	903	5,038	0	5,941
Chicago	5,376	3,574	382	9,332
Denver	9,635	6,572	322	16,529
Oklahoma	3,124	10,255	0	13,379
Phoenix	8,425	12,674	53	21,152
Seattle	1,926	2,879	6	4,811
Total	**29,389**	**40,992**	**763**	**71,144**

Source: Indian Housing Block Grant Database, FY 1998 Archives File

Another significant HUD program was the modernization program. Funds for modernization of IHA housing were provided through the Comprehensive Improvement Assistance Program (CIAP) and the Comprehensive Grant Program (CGP). The National Affordable Housing Act of 1990 expanded the allowable uses for CIAP beyond rental housing to include modernization grants for Mutual Help units, Turnkey III units, and management improvement grants for other homeownership developments. Beginning in FY 1992, the CGP provided modernization funds on the basis of a formula to public housing agencies (PHAs) with 500 units or more. In FY 1993 the threshold for participation in the CGP was lowered to PHAs with 250 units or more.

In 1996, Congress changed the way HUD implemented housing programs with the passage of the Native American Housing Assistance and Self-Determination Act of 1996 (NAHASDA). NAHASDA reorganized and simplified the process of providing Federal housing assistance by eliminating several programs (including the Low Rent, Mutual Help, and the modernization programs) and replacing them with single block grant program. NAHASDA also provided Federal assistance in a manner that recognized the

rights of tribal self-governance. NAHASDA has been the primary housing program for tribes since fiscal year 1998.

In the first year of NAHASDA, there were 71,144 Low Rent, Mutual Help, and Turnkey III units in the IHBG database. As of June 2003, there were 66,580 Low Rent, Mutual Help, and Turnkey III units remaining under management. Since 1998, 4,564 housing units were removed from the IHBG database owing to conveyances and deprogramming of units for such uses as day care or demolition. Under NAHASDA, the tribe or TDHE receives formula funding for the operation and maintenance of Formula Current Assisted Stock (FCAS). Current funding is $2,440 per Low Rent unit and $528 per Mutual Help/Turnkey III unit. Amounts are adjusted annually based on an inflation factor and local area costs. The IHBG allocation is based on Formula Current Assisted Stock (1937 Act units still under management) and need. IHBG funds may be used for staffing, housing planning and development, new construction costs, housing maintenance and repairs, housing rehabilitation, and affordable housing model projects. Section 202 of NAHASDA lists the following eligible affordable housing activities:

1. Indian Housing Assistance
2. Development
3. Housing Services
4. Housing Management Services
5. Crime, Prevention, and Safety Activities
6. Model Activities

Indian Housing Assistance allows for modernization or operating assistance for housing previously developed or operated pursuant to a contract between the Secretary of HUD and an IHA. For example, if a TDHE manages 50 Low Rent units and 20 Mutual Help units, it would receive the following amounts under the FCAS portion of the IHBG formula.

Table 9
Example of Formula Current Assisted Stock Funding Calculation

Type of Program	Number of Units	Amount Per Unit	Total Subsidy
Low Rent	50	$2,440	$122,000
Mutual Help	20	$ 528	$ 10,560
Total	**70**		**$132,560**

Source: NAHASDA Regulations

Under NAHASDA, a tribe or TDHE has the authority to spend its IHBG funds on other affordable housing activities besides operation and maintenance of Formula Current Assisted Stock units. As of June 2003, there were 31,474 Low Rent units, 34,755 Mutual Help units, 351 Turnkey III units under management, and 1,398 units still in production. Table 10 outlines the number of units under management and in development by the six area ONAP offices as of June 2003.

Table 10
1937 Act Units under Management, June 2003

Area Office	Completed Units under Management				Units in Development	Grand Total
	Low Rent	Mutual Help	Turnkey III	Total		
Alaska	1,168	3,906	0	5,074	57	5,131
Chicago	5,769	3,565	186	9,520	310	9,830
Denver	10,032	5,150	125	15,307	219	15,526
Oklahoma	3,255	8,368	25	11,648	138	11,786
Phoenix	9,170	11,299	15	20,484	580	21,064
Seattle	2,080	2,467	0	4,547	94	4,641
Total	**31,474**	**34,755**	**351**	**66,580**	**1,398**	**67,978**

Source: Indian Housing BLOCK Grant Database, June 2003

Analysis of the date of full availability (DOFA) of units still under management provides information on the production levels of new construction by decades. Table 11 lists the number of Low Rent, Mutual Help, and Turnkey III units still under management by decades by DOFA.

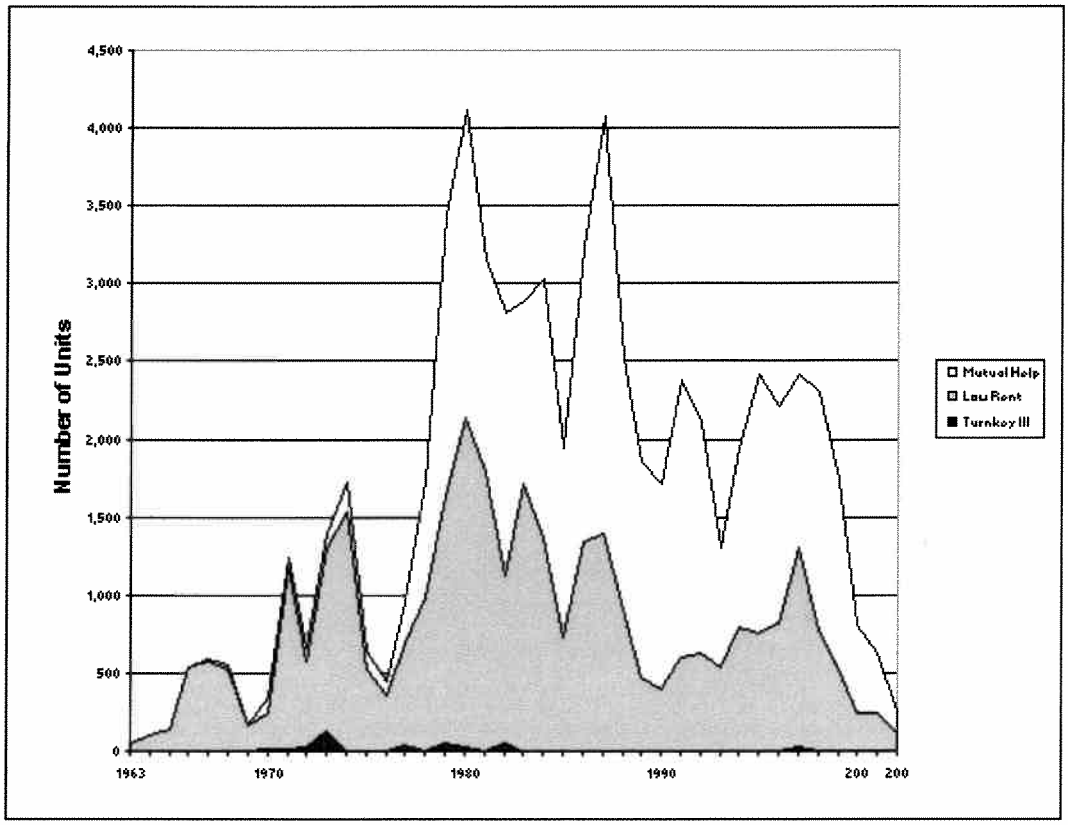
Table 11
Number of Housing Units[①] Produced by Decade

Decade	Low Rent	Mutual Help	Turnkey III	Total
1963 - 1969	2,105	35	0	2,140
1970 - 1979	8,758	3,562	256	12,576
1980 - 1989	12,912	16,663	70	29,645
1990 - 1999	7,092	13,411	25	20,528
2000 - 2003	607	1,084	0	1,691
Total	**31,474**	**34,755**	**351**	**66,580**

Source: Indian Housing Block Grant Database, June 2003
[①]Units that remain under management as of June 2003

A further analysis based on individual DOFA dates provides the following information on units constructed by year.

Table 12
Housing Unit Production
1963–2002



Source: Indian Housing Block Grant Database, June 2003

Table 12 shows the units constructed by year based on DOFA dates and the 66,580 units under management. The most productive time frame was 1978–1988 with 32,952 units built or 49.09 percent of the units. From 1989 to 1999, 22,378 units or 33.6 percent of units were built. With almost 50 percent of the housing units built from 1978 to 1988, most units are 16 to 25 years old.

Many major components—roofing, furnaces, fan motor bearings, major appliances, insulated glass units and, some would say, siding—have an expected service life of 20 to 30 years. Interior finishes also need regular replacement, including carpet and vinyl floor coverings. The age data above indicate that many of the major building components are coming due for replacement.

Wear and tear is a common problem in assisted housing units, though certainly not exclusively in assisted housing units. The ONAP Denver Program Office has been working with tribes and TDHEs to identify homeownership units that have been

conveyed to buyers. These units are removed from the management stock. IHBG funds may be used if these conveyed units have mold and moisture conditions and require more extensive remediation or repairs because of their age. The IHBG Program allows tribes or TDHEs to spend their funds on rehabilitating these units, provided low-income families occupy them. Table 13 shows the average age of homes built from 1963 to 2002.

Table 13
Average Age of Units Built, 1963 - 2002

Type of Unit	Average Age (in Years)	Percentage of Total Units
Low Rent	20.0	47.3 %
Mutual Help	14.9	52.2%
Turnkey III	25.5	0.5 %
Overall	17.4	100.0 %

Source: Indian Housing Block Grant Database, June 2003

CHAPTER 5: EXTENT OF THE MOLD PROBLEM

This chapter provides an estimate of American Indian and Alaska Native (AIAN) housing units in the six Office of Native American Programs (ONAP) Area Office jurisdictions that are affected by mold.

Canvassing Methodology

Canvassing information on the number of housing units that report mold problems was collected for the six ONAP Area Office jurisdictions. The canvassing used the following questionnaire format developed by the Seattle ONAP Area Office:

1) Has mold been reported by anyone in your tribe?
2) How many Mutual Help, Low Rent, and Turnkey III units are affected by mold?

For those regions with a low response rate, follow-up efforts were made to contact tribes for more information. Tribal housing representatives and tribal housing residents were not given a definition of a mold problem during canvassing for self-reported data. Instead, the occupant or responding tribal official used his or her own definition. There is no generally accepted definition of a mold problem in the home, but it can include: visible appearance of mold upon inspection by trained personnel, measured concentrations of mold in the air or on surfaces, or clinical diagnoses of health problems shown to be associated with mold.

Responses from the canvassing were recorded and analyzed. Tribes that did not respond to the canvassing were excluded from the data analysis. Tribes for which Indian Housing Block Grant (IHBG) database numbers of Low Rent, Mutual Help, and Turnkey III units were not available were also excluded from the data analysis. A total of 542 tribes and 66,580 housing units comprised the universe for this canvassing. The number of housing units is based on the total number of Low Rent, Mutual Help, and Turnkey III units in the most recent IHBG database. Canvassing provided the following information:

1. The number of housing units by ONAP Area Office jurisdictions as well as tribes that responded to the canvass and for which IHBG housing numbers were available.

2. The number of housing units by ONAP Area Office jurisdiction as well as tribes that have mold problems as reported by the tribal official who responded to the canvass.

Canvassing Results

The canvassing effort received responses from 20 percent of the tribes, which represented 43,532 housing units or 65 percent of the total of 66,580 housing units. The data collected indicate that an estimated 6,743 housing units (15 percent) of the 43,532 units represented in the canvass had reports of mold. Based on the percentage of units reporting mold in each ONAP Area Office jurisdiction, the number of units projected to have mold and moisture problems was calculated. For example, Alaskan tribes representing 3,269 housing units responded to the canvass. Of the 3,269 units, 1,214 units (37 percent) reported mold problems. This percentage was multiplied by the total 5,074 units in the Alaska region, resulting in an estimate of 1,877 units with reported mold problems. By adding the calculated estimates for the six ONAP Area Office jurisdictions, 9,529 units or 15 percent of housing units are estimated to have reported mold problems.

As shown in Table 14, the rates of reported mold problems vary widely from area to area. Some of these differences can be attributed to geographical and climate differences. Areas where climate and temperature vary greatly or have high levels of rainfall tend to have more mold problems, unless steps have been taken to prevent excess moisture in the home. Warm, dry weather, as in the Southwest, may reduce the degree to which rain and other moisture sources affect homes.

Table 14
Extent of Mold in American Indian and Alaska Native
Low Rent (LR), Mutual Help (MH) and Turnkey III (TK) Housing

ONAP Area Office	Total Housing Units	Canvass by Area Office				Projected Total Units with Mold
		LR, MH, TK Units Canvassed		LR, MH, TK Units Reporting Mold		
		Number of Responses	Response Rate	Number	Percent of Units Canvassed	Units
	(a) = *Total units*	(b) = *responses*	(c) = *(b)) (a)*	(d) = *units with mold*	(e) = *(d)) (b)*	(f) = *(a)* x *(e)*
Alaska	5,074	3,269	64%	1,214	37	1,877
Chicago	9,520	5,629	59%	1,372	24	2,285
Denver	15,307	11,696	76%	2,349	20	3,062
Oklahoma	11,648	8,465	73%	237[1]	3	349
Phoenix	20,484	10,491	51%	224	2	410
Seattle	4,547	3,982	88%	1,347	34	1,546
Total	66,580	43,532	65%	6,743	15	9,529

Source: 2003 Canvass of Tribal Housing Units

[1] Canvass data appear low in comparison with anecdotal findings during site visits.

CHAPTER 6: BUILDING AND SITE PROBLEMS CONTRIBUTING TO THE ROOT CAUSES OF MOLD

This chapter discusses the chain of conditions that lead to mold contamination in housing. First, the physical moisture conditions that result in mold contamination are identified and classified. Secondly, the underlying root causes that lead to these moisture problems are identified. An understanding of the root causes provides the basis for effective interventions and solutions.

During the 21 site visits to tribes with report mold problems, inspectors consistently found mold contamination on wet or moist surfaces and identified the conditions that lead to high moisture levels and mold contamination. These conditions have two moisture sources: bulk water entry and condensation.

Bulk water entry is simply unintentional water leaks in a building. Water entry can be traced from the area of water damage and mold growth back to the source of the leak. This is typically along a pathway caused by gravity or capillary action. Common water entry problems include:

- Roof and cladding leaks – Rainwater and occasionally snowmelt that enters through holes in the exterior envelope of the building.

- Plumbing leaks – Leaks in plumbing supply or waste lines. Bathroom moisture and spillage are included in this category.

- Foundation leaks – Rainwater and snowmelt that enters the foundation of a building, either into basements, crawl spaces, or through a slab-on-grade foundation.

In many cases, bulk water entry is related to rainwater and therefore often a spring and summer problem, although plumbing and foundation moisture can occur in any season. In contrast, condensation occurs when warm, humid air comes into contact with a cold surface. A common example of condensation is visible water droplets on a bottle taken out of the refrigerator on a warm, humid day. However, water droplets need not appear on a building surface to lead to mold growth. Building materials have moisture storage capacity, and condensation will lead to higher moisture content in building materials before visible water droplets form. Complete saturation is not required, as mold contamination can start when a building material reaches 80 percent of moisture storage capacity.

Solving water entry problems generally requires tracing the water source back to the leak, stopping the leak, and repairing any damage. The path that water takes to get inside the home may be varied and complicated. Wet basements, for example, may have many sources. Remediation techniques depend on the source of water and can include 1) treating rain gutters and the soil surface, 2) improving exterior perimeter drainage, 3) using waterproofing liners on the outside or inside walls, and 4) using interior drainage

and sump pumps. Selecting the approach or combination of approaches may be a matter of site conditions and financial resources.

Condensation problems occur in a building as a result of two contributing conditions: 1) high interior relative humidity, and 2) a chilled surface somewhere in the building. The colder a surface, the less interior humidity is required to lead to condensation moisture problems. The higher the relative humidity, the less surface temperature depression is required to lead to condensation moisture problems. Because of the likelihood of cold surfaces, condensation moisture problems present during cold winters affect many parts of the United States. In warm, humid climates that depend on air conditioning for most of the year, such as Florida and the Gulf Coast, condensation problems can occur during the summer, when moisture-laden exterior air finds condensing surfaces in buildings cooled by air conditioning.

Because of the dual nature of condensation moisture problems, their solution requires identifying the moisture sources leading to high interior humidity as well as the reasons some surfaces becoming overly chilled. The best solutions may involve eliminating both contributing factors.

Building and Site Problems By Site Visit Classification

This section discusses the nine most common building and site moisture problems found during the mold assessment visits.

1. Site Drainage Problems

Mold problems are related to moisture problems. The most common source of water entry into buildings is rainwater entering through the base of the building. In general, elevated sites are more suitable for residential development than low-lying sites. Of all the factors affecting mold growth, site drainage is the physical factor with the highest priority. Water from below grade should not be allowed to enter the foundation. This is accomplished by:

- Selecting foundation type according to water table type (basements are suitable for low water tables; slabs are appropriate for high water tables);
- Crowning the building site so rainwater on the site drains away from the building;
- Providing drainage at the footing and beneath a slab to either daylight, storm drains, or a sump pump; and
- Providing a designated outlet for the sump pump discharge.

In principle, the soil surface should act as a roof system, draining water on the surface and preventing penetration of the water to the soil below. Dry soil cannot lead to water leakage to the interior of the building. Sometimes site drainage must be improved.

For example, a swale can be created on the uphill side of a building lot to divert rainwater to either side of the house (Figure 4). The swale acts like the cricket in a roof assembly, diverting roof rainwater to either side of a roof penetration such as a chimney. Soil should slope away from the building at a 5 percent slope for the first 10 feet around the building. This corresponds to a six-inch fall in the first 10 feet.

Figure 4. Site Drainage - The swale on the uphill side of the lot diverts water around to the side of the house.

2. Gutter and Downspout Problems

The gutter system is the element of building construction that handles the highest concentration of water. Good gutter systems are the key to exterior rainwater management. They may need maintenance, particularly in areas with many trees and foliage. Ice or water loading may dislodge gutters from the fascia or from the downspout hangers. Elbow sections may become disconnected. It is important to discharge roof rainwater well away from the base of the building. This usually means adding a splash block or downspout extender to the end of the downspout. However, extenders and splash blocks are commonly displaced (Figure 5). When this happens, water tends to saturate the soil in the area of the downspout and this leads to wet basements, crawl spaces or slabs. Houses without gutters must have the same level of rainwater management as houses with gutters.

Figure 5. Gutter System - The missing downspout has led to severe rotting of the siding materials.

3. Leaks From the Exterior

It may seem obvious that rainwater should not be allowed to enter the building through the roof or walls. However, the problem is quite common. Even small leaks can lead to severe damage (Figure 6).

While roof leaks may be obvious and easily repaired, other leaks, such as leaks around windows, can be aggravating, but more difficult to solve.

Figure 6. Leaks from Exterior - A roof leak has caused this severe deterioration of the ceiling materials.

4. Wet Basement and Crawl Space

Basements are often areas of wetness. Water from outside gravitates to low areas, and the lowest area is often the excavation for building foundations. To keep a basement or crawl space dry requires opposing the natural forces of gravity and capillary action.

The principal strategy for dry basements and crawl spaces is exterior rainwater management, discussed above. Drainage tile may help, but is very hard to inspect for continued operation. Damp proofing on the outside of a basement wall may also help, but cannot work if the soil in contact with the wall is allowed to soak up to water saturation. Basement walls that have a great difference in elevation between the indoor floor elevation and the outside grade are most at risk.

Crawl spaces are also troublesome. The soil must be covered to prevent evaporation (Figure 7). This is a bare minimum moisture control requirement. Measures must be taken to prevent water entry from outside into the crawl space. One of the most common sites of water entry found in site visit inspections was in crawl space vents originally designed to assist in drying.

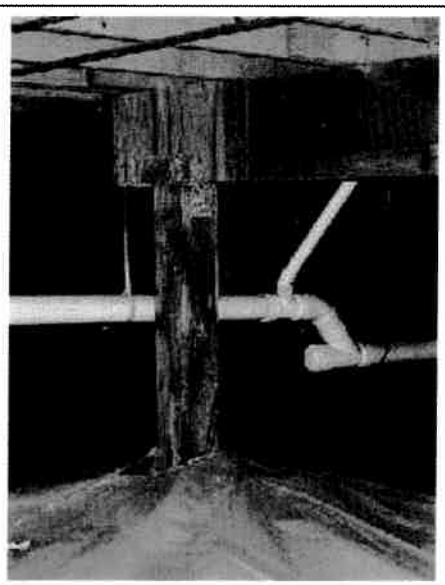


Figure 7. Basement and Crawl Space - The ground cover in the photo is necessary to prevent evaporation of water from the soil beneath.

Crawl spaces are rarely inspected or visited. Many construction defects can be found in crawl spaces, including disconnected plumbing, disconnected ducts, rotting structural members, trash, and vermin.

In better basement and crawl space construction, the ground surface contains a drainage system, so any water entering the slab or crawl space floor is drained to a sump pump, which has a well-designed outlet.

5. Plumbing Problems

Mold and moisture problems caused by plumbing problems can be easily fixed. These include:

- Leaks in water supply from freezing or excess pressure.
- Leaks in drain-waste-vent (DWV) systems usually owing to poorly executed plumbing joints (Figure 8).
- Fixtures that are poorly connected to DWV, especially at toilets.
- Surface condensation on toilet tanks.
- Splash at fixtures, especially at the tub surround.

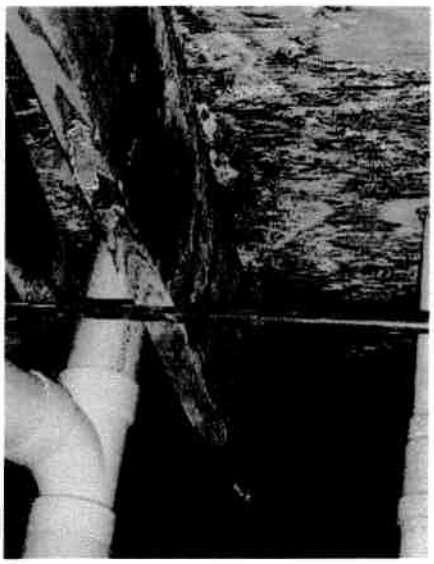


Figure 8. Plumbing - Leaks from the fixtures above these plumbing drains have led to severe deterioration of the floor deck and floor joists.

6. Bathroom Problems

The most common bathroom problem is shown in Figure 9. Toilets are often installed very close to the tub surround. Tub edges are rarely designed to remain dry during a shower, even with moderately careful use of a shower curtain. The toilet, too, may contribute water, either from toilet splash during use, or from condensation on the toilet tank. The close quarters make maintenance and repair very difficult. Leaks of drain piping under the lavatory are common as well and not readily apparent.

Bathrooms collect and hold water for a long time and so they may become moldy over time. With a small number of occupants taking short showers, opening the bathroom door after a shower may be all that is necessary to bring down bathroom humidity. However, in most cases a bathroom fan must be installed and used to prevent mold and surface discoloration on bathroom walls and ceilings.

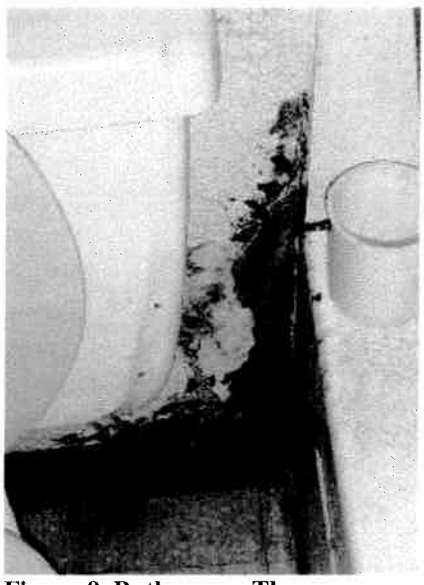


Figure 9. Bathroom - The wallboard between the tub and the toilet is a common site of deterioration.

7. Exhaust Ventilation Problems

Bathroom exhaust vents were first introduced to control odors, but their role quickly turned to controlling moisture. A good bathroom fan should be quiet, long-lived, and vented to the outside, attic, or crawl space. Its capacity should match the size of the bathroom. It should operate either manually or mechanically after a shower, until the air returns to the level of the house humidity. The exterior outlet should be protected against entry of rain and snow. In low-income housing, it is common to find inadequate, noisy, and poorly installed fans (Figure 10). This poor installation may lead to problems as severe as if there were no fan at all.

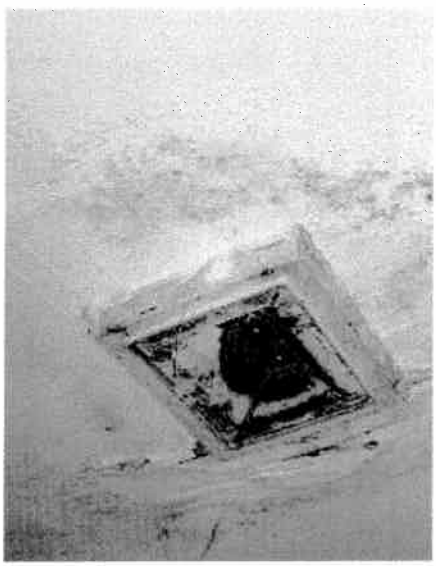


Figure 10. Exhaust Ventilation - Poor installation of the exhaust fan led to water damage in the area of the fan.

8. Exterior Wall and Ceiling Problems

In areas with cold winters, building surfaces become chilled. When that condition combines with high indoor humidity, the surfaces may become wet and stay wet. Wet surfaces may be sites of mold growth (Figure 11).

The most common sites of condensation problems include:

- Where the wall meets the ceiling, especially where the junction is not insulated or is poorly insulated.
- Closets that are not heated.
- Condensation on windowpanes that drips down onto the window frame.

Solving such problems requires making the insulation more complete, reducing the humidity load at the interior of the building, or both.

Figure 11. Exterior Wall/Ceiling - The combination of cold surface temperatures and high humidity lead to the class of problems called condensation problems.

9. Attic Problems

Problems caused by frost or moisture accumulation usually occur in attics. During cold weather chilled sheathing combined with moist air from the interior of the house can lead to sheathing deterioration and mold (Figure 12). It is important to prevent the flow of humid indoor air up into the attic, by blocking any holes between the inside and the attic. Attic ventilation is commonly recommended to prevent moisture problems. In general, attic ventilation may be helpful in northern states, but will not prevent moisture problems in southern states. Attic ventilation may be essential in preventing ice dams in areas of extreme cold.

Figure 12. Attic - Currents of air with high moisture combine with cold sheathing temperatures to create sheathing deterioration.

Root Causes of Mold and Moisture Problems

The nine categories of physical conditions leading to mold and moisture problems, presented above, establish the types of physical remedial action required to eliminate specific areas of mold contamination. Repairing roof and plumbing leaks, installing ventilation, maintaining gutters, and other physical repairs are well understood and do not require further elaboration. These activities, however, are responses after the fact. To prevent recurring mold and moisture problems in AIAN housing, the root causes that lead to physical degradation must be understood.

Root causes are those factors that allow physical moisture problems to develop in the first place, and allow those problems to linger so that substantial mold contamination can occur over time. Root causes can be placed into four categories:

1. Design and construction – Conditions that result from design decisions, detailing, and execution at the time of construction. Site selection, site grading, and foundation construction are perhaps the most essential aspects of project design. This category also includes installation of insulation, exhaust ventilation, roof flashing and roof drainage design, HVAC design, and planned air exchange with the exterior.

2. Tribally Designated Housing Entity (TDHE) maintenance – Conditions that result from lack of maintenance. This refers to larger maintenance items for which the TDHE is responsible. These larger items include roof and cladding repair, repair of HVAC and ventilation systems, plumbing maintenance, and foundations.

3. Occupant maintenance and practices – Conditions that result from lack of occupant maintenance and practices. Smaller maintenance items are typically considered the responsibility of the residents, but can play a large role in the

moisture conditions of a residence. Occupant practices can have a similar impact. This category includes bathroom use and care, the use of humidifiers, failure to use exhaust ventilation, storage in basements and closets, removal of leaders from gutter systems, laundry habits and interior clothes drying, the control of heat distribution in the winter, and the frequency and effectiveness of maintenance cleaning.

4. Overcrowded housing and low-income status – Conditions caused by high density in housing and other issues related to low-incomes. By multiplying the human moisture sources, such as cooking, cleaning, showering, and natural respiration, overcrowding can place an excessive moisture load on a residence. It can lead to the improper use of damp basements and the storage of an excess amount of personal belongings. In an effort to save financial resources, low-income families are more likely to circumvent heating systems by shutting off rooms and using unvented combustion appliances.

It should be noted that root causes 2 and 3 are closely related because they both involve maintenance procedures. Indeed, the clarity to which TDHE and resident maintenance responsibilities are defined and separated was identified as a critical component to maintenance programming. Additionally, communication between residents and maintenance departments is also crucial. Effective maintenance requires both prompt reporting of moisture conditions by residents and prompt response by the maintenance department. A failure from either party can allow a minor moisture problem to develop into a significant mold problem. Ultimately, maintenance implies a partnership between residents and the TDHE, and establishing programs and procedures that effectively govern that partnership is the basis of a solid maintenance program.

The root causes suggest the intervention points for solving mold and moisture problems in AIAN housing. Long-term solutions involve providing technical assistance and training to enable TDHEs to develop moisture resistant housing designs for new construction. Solutions also involve providing training to both maintenance departments and residents regarding mold problems, and improving the procedures that direct maintenance practices. Programs to alleviate overcrowding will also play a role. These concepts form the basis of the recommendations presented in Chapter 9.

Tables 15 and 16 illustrate the relationship between the physical moisture problem (listed in columns) and the root causes (listed in rows). The intersection of the rows and columns display the conditions and contributing factors that result in mold and moisture problems.

Table 15 outlines bulk water entry problems, and includes three columns on the three basic categories described above: 1) roof and cladding leaks, 2) plumbing leaks and bathroom moisture, and 3) foundation leaks. Table 16 examines condensation moisture problems, and is divided into two columns on the basic contributing factors: high interior humidity, and cold condensing surfaces.

Table 15
Bulk Water Entry Conditions

Causes and Contributing Factors	Roof and Cladding Leaks	Plumbing Leaks and Bathroom Moisture	Foundation Leaks
Design and Construction Issues	• **Ice Damming** - Vagrant heat loss into attic from ceiling bypasses and/or insufficient insulation.	• No local **exhaust ventilation** installed, or poorly designed exhaust ventilation system	• **Site grading** - poor drainage away from foundation • **Roof Drainage** - no gutter system installed • **High water table** - poor site selection for housing • **No vapor barrier** in crawl space • **No footing drain** system
Housing Authority Maintenance Issues	• **Leaks at Flashing** - Water entry around chimneys, dormers, valleys, dripcaps, etc. • **Deteriorated Cladding** - water entry through worn siding, shingles	• **Leaks in water supply** - to sinks, showers, toilets, washers, hose bibbs, etc. • **Leaks in DWV** - drains, toilet seals, washing machines, etc. • **Leaks in tub and shower surrounds** • **Inoperable exhaust fans**	• **Roof drainage** system not maintained • **Sump pump** and discharge system not maintained
Occupant Maintenance and Lifestyle Issues	• **Failure to notify** maintenance staff regarding roof and cladding leaks	• **Lack of care** in preventing toilet, tub, and shower spillage • **Lack of cleaning** to keep mold and moisture in check • **Failure to use** local exhaust ventilation • **Failure to notify** maintenance staff regarding plumbing leaks	• Use of **carpets** on basement floors and slabs • **Basement clutter**- cardboard boxes, paper, and fabrics stored in wet basement • **Disabling roof drainage**- removing downspouts and leaders on roof drainage system
Overcrowded Housing and Low-Income Issues		• **Occupant density** multiplies bathroom use and associated moisture problems	• **Inappropriate use of basements** - using damp basements as bedrooms
Mold Contamination Sites	• Walls • Ceilings and ceiling • Floors and subfloors	• Walls • Ceilings • Floors and subfloors • Cabinent interiors	• Foundation Walls • Foundation floors/soils • Framing and subfloor sheathing • Personal possessions/clutter • Interior basement finishes • Elsewhere in house, as contributor to high moisture load (*see Table 16*)

Source: Site Visit Database

Table 16
Condensation Moisture Conditions

Causes and Contributing Factors	High Moisture Load Sources (Relative Humidity)	Chilled Surfaces (Condensation Locations)
Design and Construction Issues	• **Foundation Moisture Sources** (*See Table 15*): design issues regarding site drainage, roof water drainage, crawl space wetness, high water table, etc. • **Overtight Houses**- insufficient fresh air exchange (planned ventilation) for moisture dilution • **No localized exhaust ventilation** - both bathrooms and kitchens, particularly with gas appliances • **Construction Moisture** - in first year of occupancy	• **Inadequate central heating** - poorly designed heating and heat distribution leading to cold rooms and interior surfaces • **Missing or inadequate insulation** - in walls, ceilings, foundations. A particular concern at the wall/ceiling juncture of outside walls. • **Exhaust fans venting into cold spaces** - bathroom and kitchen fans venting into attic or crawl space
Housing Authority Maintenance Issues	• **Combustion Moisture Sources** - from poorly tuned and backdrafting combustion appliances • **Foundation Moisture Sources** (*See Table 15*): maintenance issues regarding roof water drainage, crawl space wetness, sump pump discharge, etc.	• **Poor heat distribution** - Lack of maintenance of heating plants and heat distribution systems
Occupant Maintenance and Lifestyles Issues	• **Bathroom spills and moisture sources** - failure to control spills or use exhaust fan • **Dry Clothes indoors** - including clothes dryers not vented to the exterior • **Lack of knowledge** of mechanical ventilation systems and their use • Inappropriate use of **humidifiers** • **Human Moisture Sources**: respiration, clothes washing and drying, showers, cooking, and cleaning.	**Poor Heat Distribution** - closing off or obstructing supply vents, shutting off rooms from heat sources, and otherwise impacting the even distribution of heat. **Excessive clutter** on exterior walls, particularly on exterior walls of closets; prevents warming of wall surfaces.
Overcrowded Housing and Low-Income Issues	• **Human Moisture Sources**: human sources are multiplied in overcrowded conditions, and can be critical cause of high moisture load • **Combustion Moisture Sources** - Use of unvented combustion appliances to reduce heating costs	**Poor Heat Distribution** - impacting even heat distribution, described above, often results from closed vents, etc. **Excessive clutter**, as described above, is often the case in overcrowded houses.
Mold Contamination	• Ceilings • Exterior walls, particularly in closets • Wall/ceiling juncture on exterior walls • Roof sheathing • Wall sheathing	

Source: Site Visit Database

CHAPTER 7: SITE VISIT SUMMARIES

Tribes/TDHEs submitted requests to Office of Native American Programs (ONAP) Area Offices for technical assistance and assessments of reported mold in housing units. In response, inspection teams trained in mold identification and remediation visited 21 tribes to assess reported mold and moisture problems during a 10-month period (see Table 17). A total of 175 housing units were inspected for mold and moisture problems.

The TDHE at each tribal location arranged the inspection visits to the individual housing units. The selected houses were not a random sample as the TDHE at each tribal location arranged inspection visits to include units with known or self-reported mold problems. A couple of site visits included the inspection of a few houses that did not have known or reported mold problem but were representative of the typical building stock and houses that had previously undergone remediation work. For this reason, not all inspected buildings had visible mold or identifiable moisture problems. Despite the inclusion of housing units that did not have known or reported mold problems, inspection teams identified 109 houses (62 percent) with visible mold, and 149 houses (85 percent) with identifiable moisture problems. These findings show that resident reports of mold are reliable indicators for mold and moisture problems in housing.

Table 17
Site Visits Conducted

Tribes	State	Dates Visited
Seneca Nation	New York	Aug. 5-9, 2002
White Earth Band of Chippewa	Minnesota	Sept. 23-27, 2002
Lac Du Flambeau Band	Wisconsin	Nov.3-6, 2002
Lac Vieux Desert	Michigan	Dec. 1-2, 2002
Bad River	Wisconsin	Dec. 3-4, 2002
Red Cliff	Wisconsin	Dec. 5-6, 2002
St. Regis	New York	Dec. 9-11, 2002
Oneida	New York	Dec. 12, 2002
Cherokee Nation	Oklahoma	Jan. 14-15, 2003
Walker River	Nevada	Jan. 27-29, 2003
Ho-Chunk Nation	Wisconsin	Feb. 10, 2003
Copper River	Alaska	Feb.17-18, 2003
Kenai	Alaska	Feb.17-18, 2003
Fort Belknap	Montana	Mar. 4-7, 2003
Nisqually	Washington	Mar. 10-13, 2003
Skokomish	Washington	Mar. 10-13, 2003
Lac Courte Oreilles	Wisconsin	April 28 – May 1, 2003
Fond Du Lac	Minnesota	May 2, 2003
Turtle Mountain	North Dakota	May 5-9, 2003
Spirit Lake Tribe	North Dakota	May 19-23, 2003
Mille Lacs Band	Minnesota	May 27-30, 2003

Site Visit Methodology

The inspection teams relied primarily on visual inspection to assess mold and moisture conditions. Assessment forms developed for the Chicago Mold and Moisture Project, a HUD Healthy Homes Program, were used to record information. At each house, the inspectors performed a room-by-room assessment of moisture and mold problems. All rooms were examined for water damage and evidence of mold. Inspections included

exterior and interior conditions and, where accessible, assessments of attics and crawl spaces. Normally, the assessments included kitchens, bathrooms, basements, and utility rooms. Additionally, inspectors checked plumbing, localized ventilation, water entry and other moisture sources. House exteriors were inspected for rainwater and snowmelt management, including site grading, roof condition, and gutter system.

Notes of relevant conditions were documented on standardized forms. Digital photographs also documented conditions. When appropriate, the inspectors used varied instruments to measure temperature, humidity, moisture content, airflow, etc., to help diagnose moisture source problems. Because of the moisture storage capacity of wood, moisture content measurements provide information on wetness in the recent past, from three weeks up to a month. Whenever possible, residents were interviewed to gather history on moisture problems, plumbing leaks, winter condensation, health issues, number of occupants, and other useful information.

Data from the inspections were entered into a database, organizing moisture problems into the following nine categories:

1. Site Drainage Problems
2. Gutter System Problems
3. Leaks from Exterior
4. Wet Basement or Crawl Space
5. Plumbing Problems
6. Bathroom Problems
7. Exhaust Ventilation Problems
8. Exterior Wall/Ceiling Problems
9. Attic Problems

The database identified the location of visible mold by problem category. A technical report was prepared for each house detailing the moisture problems and providing rehabilitation recommendations.

Mold Sampling

Mold sampling was not done at any of the site visits. The literature review found that mold sampling is discouraged in most cases. The Centers for Disease Control and Prevention does not recommend routine sampling for molds as "reliable sampling for mold can be expensive, and standards for judging what is and what is not acceptable or tolerable quantity of mold have not been established" (CDC, 2003). Although mold sampling is sometimes done in residential settings, it is not required to identify the presence of mold, the presence of various species of mold, or the amount of mold in certain locations. Some factors about mold sampling make the results less useful:

1. Since mold is everywhere, it will show up in all air samples. It is perfectly normal to find mold spores in the air, since they are naturally occurring.

2. Building cavities contain high concentrations of mold spores and mold materials. Since buildings serve as filters between the indoor and outdoor environment, accumulation of mold material in building cavities is expected.

A more thorough explanation on the limitations of mold sampling is in Appendix D.

Summary of Site Visit Assessments

The following six site visit summaries highlight housing conditions encountered in each ONAP Area Office jurisdiction and offer recommendations to address the mold and moisture problems.

Eastern/Woodlands Area Office
Bad River Reservation Site Visit
December 3-4, 2002

The Bad River Reservation is in Ashland and Iron Counties in the northern section of Wisconsin. The region's winter climate consists of cold temperatures and heavy snowfall. The region has many lakes, streams, and rivers, along with wetlands and marshes. Tribal staff reported high water tables. This type of topography can contribute to mold and moisture. There are about 2,086 American Indians and Alaska Natives living on the reservation. TDHE maintains 192 IHBG-funded units, of which 167 are Low Rent, 24 are Mutual Help, and one is a Turnkey unit.

Bad River Reservation Findings

1. Site drainage was poor at several homes. The grade adjacent to the homes was flat. Numerous holes and dips were found around the perimeter of the homes. Crawl space vents were near grade. Rain water and snow melt were not adequately diverted from the house foundations.

2. Several homes had no gutters or down spouts and of those that did, many had broken or missing downspouts. Drip lines were visible around the perimeter of homes. The lack of adequate rainwater management systems compounds poor site drainage. The installation of gutters, downspouts, leaders, and splashblocks to drain water away from houses would improve site drainage. Moving water away from the homes reduces the negative effect of current site drainage conditions on wet foundations.

3. Crawl spaces showed problems with site drainage, clutter, and ductwork. Installation of gutters, downspouts, leaders, and splashblocks near the crawl space would eliminate moisture in crawl spaces. Keeping clutter out of the crawl space and using insulation and proper ductwork would eliminate other moisture problems.

4. Improperly vented bathroom and kitchen exhaust fans contribute to mold growth on roof sheathing. Large amounts of moisture can be generated in bathrooms and kitchens. Properly operating exhaust fans are key to removing moisture from these spaces and lowering the moisture load in homes.

5. A number of maintenance issues contribute to moisture and other indoor air quality issues, including leaky and disconnected ductwork, poorly maintained or operated sump pumps, and poorly insulated attic hatches and attics.

6. Occupant practices also contribute to moisture and other indoor air-quality issues. These include clutter in crawl spaces and basements (including firewood) and dust accumulation on window sashes, which, with moisture, provide a medium for mold growth.

Southern Plains Area Office
Cherokee Nation Site Visit
January 14, 2003

The Cherokee Nation covers 14 counties in northeastern Oklahoma. The region's winter climate is generally temperate. The tribal land has many lakes, streams, and rivers among rolling hills. The Cherokee Nation's Tribal Jurisdictional Statistical Area (U.S. Census), is the second largest American Indian and Alaska Native (AIAN) community in the United States. Almost 100,000 Cherokees live in this area. The TDHE of the Cherokee Nation manages 4,160 housing units, of which 1,716 are Mutual Help, 973 are Low Rent, and 1,471 are Section 8 Certificate units.

Cherokee Nation Housing Findings

1. Exterior site drainage and rainwater management was a problem in most of the residences. Site drainage was rated poor or worse at six of the seven homes. Many of the sites were flat with no slope away from the foundation. In some cases, a hillside drained toward the home. All seven houses were missing roof drainage systems (gutters, downspouts, leaders, etc.), which can place a tremendous moisture load on the foundation and the house.

2. In the three site-built houses with crawl spaces, construction of the crawl spaces was substandard. There were no vapor barriers covering the soil in the crawl spaces. In some cases, the wet conditions were promoting mold growth. Some of the rot damage to the sub-floors had created structural safety problems.

3. Three houses had mold due to winter moisture condensation. Mold growth from condensation sources was visible in bedroom closets, at the wall–ceiling juncture of exterior walls, and at the base of exterior walls.

4. Bathrooms and bathroom exhaust ventilation had significant problems. Operable exhaust fans were missing in six of the seven homes, including two of the homes with condensation problems.

5. Two of the inspected houses were overcrowded. Overcrowding multiplies the moisture generation from human sources and can contribute to elevated interior moisture loads, and ultimately (if other conditions are in place) lead to mold contamination from condensation. There was condensation and related mold contamination in both overcrowded houses inspected.

6. Of the seven inspected homes, only one had a central heating system. Heating method and heat distribution play vital roles in preventing wintertime mold and moisture problems. Additionally, the heating systems in the inspected houses presented other health and safety issues, including fire safety and exposure to carbon monoxide and other combustion byproducts.

7. Several maintenance problems contributed to mold and moisture. Water entry through roof leaks, as well as plumbing leaks, was evident in four of the seven houses.

Alaska Area Office
Copper River Basin Site Visit
February 19-20, 2003

The Copper River Basin Regional Housing Authority (CRBRHA) is located near the town of Glenallen in the Copper River Valley of Alaska. The valley is approximately 1,500 feet above sea level and is surrounded by mountains. The climate of the region is very cold and dry. Mean temperatures in the winter are below 0° F, with mean minimum temperatures well below zero. Summers are temperate, with mean temperatures in the 50s. Average rainfall at Glenallen is only 11.2 inches annually, most falling in the summer months. The CRBRHA manages 117 housing units for nine Alaska Native Villages, of which 32 are Mutual Help and 85 are Low Rent units.

Copper River Basin Findings

Visible mold was found in three homes, although in two cases the mold appeared to be dormant. A wet crawl space and cold spots on the exterior wall appeared to be the cause of mold in one home, a previous plumbing leak the cause in the second home, and residual construction moisture the source in the third.

All five properties were built over crawl spaces. Two sites had wet crawl spaces. Two other crawl spaces, although dry at the time of the site visit, showed signs of previous water problems.

Other principal findings include:

1. The grade of the site was flat. Snow piles from plowed snow and snow sliding off roofs were found next to homes.

2. Except for the new duplex, ventilation was poor with exhaust fans either absent, not operating, or operating inadequately. Ventilation systems that work properly are needed.

3. The heat recovery ventilation (HRV) system found in one home appeared to be well designed and functioning properly.

4. None of the homes had gutter systems, however, this is not considered a major issue since the climate is relatively dry.

5. No significant plumbing or bathroom problems were found.

6. No exterior wall–ceiling joint or attic problems were found.

Northern Plains Area Office
Fort Belknap Indian Community Site Visit
March 4-7, 2003

The Fort Belknap Indian Community is in Blaine and Phillips counties in Montana between the Milk River and Little Rocky Mountains. The combined reservation and trust lands encompass 705,067 acres of rolling plains and grasslands of north-central Montana. The reservation is close to the Canadian border. Average annual rainfall is 11.95 inches and snowfall is 27.6 inches. Average monthly temperatures range from 15.3° F in January to 69.6° F in July. Some 2,900 American Indians live on the Reservation and trust lands. The housing entity maintains 560 housing units, of which 249 are Low Rent and 311 are Mutual Help units.

The inspection team visited 11 homes on the reservation. All were ranch style with two or three bedrooms built over crawl spaces. Most used natural gas furnaces as the primary heating source. The homes were 2 to 34+ years old.

Fort Belknap Indian Community Findings

1. Exterior site drainage and rainwater management was a problem in six of the 11 residences. Many of the sites were flat with no slope away from the foundation. In two cases, a hillside drained toward the homes. Ten homes were missing roof drainage systems (gutters, downspouts, leaders).

2. In several instances there were no vapor barriers covering the soil in the crawl spaces. In some cases, the wet conditions promoted mold growth.

3. Seven houses suffered from mold growth as a result of winter moisture condensation. Mold growth from condensation sources was visible in bedroom closets, at the wall–ceiling juncture of exterior walls, and at the base of exterior walls.

4. Poor to nonexistent bathroom exhaust ventilation systems were significant problems in the homes. Properly operating exhaust fans were missing in five of the 11 homes.

5. Three inspected houses were overcrowded. Overcrowding increases the moisture level produced from human sources, contributing to elevated interior moisture loads, and ultimately leading (if other conditions are in place) to mold contamination from condensation. Condensation and related mold contamination occurred in two of the overcrowded houses.

6. Ten homes had central heating systems and one had baseboard electric heat.

7. Several maintenance problems contributed to mold and moisture conditions. Plumbing leaks were evident in seven of the 11 houses. Two other units had other types of plumbing problems.

Northwest Area Office
Nisqually and Skokomish Site Visits
March 10–13, 2003

The Skokomish Reservation is in Mason County and the Nisqually Reservation is in Pierce and Thurston counties, both of which are on the Olympia Peninsula in Washington. The reservations are located in the Puget Sound region. Two mountain ranges, the Olympics to the West and the Cascades to the East, surround the region. The region has fertile farmland and lush forests with average annual rainfall from about 66.19 inches in Shelton to about 51.25 inches in Olympia. The average annual snowfall is about 8.2 inches in Shelton and about 18.1 inches in Olympia. Average temperature ranges from 60 degrees to 40 degrees F. Approximately 1,690 American Indians live on the Skokomish Reservation and 1,010 live on the Nisqually Reservation. The housing entity maintains 79 housing units for the Skokomish Tribe, of which 15 are Low Rent and 64 are Mutual Help units. The entity maintains 96 housing units for the Nisqually Tribe, of which 10 are Low Rent and 86 are Mutual Help units.

A total of nine homes were inspected at both reservations. All nine were stick-built with two, three, or four bedrooms. All but one were built over crawl spaces and used wood burning stoves and electric furnaces for heat. In most cases, residents used wood stoves as the primary heating source and electric furnaces for back up. The homes ranged from 1 to 34 years old.

Nisqually and Skokomish Reservations Findings

1. Three of the nine houses had site drainage problems.

2. All nine homes had problems with roof drainage systems (gutters, downspouts, leaders, and splashblocks). These can result in foundation wetness and elevated moisture levels in the houses.

3. One home had significant mold growth on walls and ceilings as a result of winter moisture condensation. Two others had minor mold growth from this condition (other houses had condensation on windows only). These problems resulted from elevated moisture loads combined with insulation problems.

4. Four homes had excessive moisture and mold growth on bathroom walls and ceilings. These homes were crowded, with five to seven occupants. In these cases, the intensive use of the bathrooms, particularly showering, allows lingering water vapor to maintain sufficient moisture on the wall and ceiling surfaces for mold to grow. Efficient bathroom exhaust fans are the best solution.

5. Two homes were overcrowded. One had seven residents in a two-bedroom ranch house. The other had six residents in a three-bedroom ranch home. Overcrowding increases moisture levels produced from human sources, contributing to elevated interior moisture loads, and ultimately (if other conditions are in place) can lead to mold contamination from condensation. There was condensation and related mold contamination in both overcrowded houses.

6. Occupants in only two of the nine properties were using central heating as the principal heat source. The other seven houses were heated with wood stoves in the central living room. The heating method and subsequent heat distribution play a role in preventing winter mold and moisture problems.

Southwest Area Office
Walker River Site Visit
January 27–29, 2003

The Walker River Reservation is in Churchill, Lyon, and Mineral counties in Nevada. The region is in the high desert, at about 3,934 feet above sea level. The average temperature is 67 degrees F, with about 4.88 inches of precipitation annually. Winter low temperatures can reach 0 degrees F. Summer highs may exceed 100 degrees F. About 700 American Indians live on the reservation. The housing entity maintains 196 housing units, of which 68 are Low Rent and 128 are Mutual Help units.

The homes investigated are known as Project NV99B008010. The project has 20 Mutual Help homes, which are all modular with two, three, or four bedrooms, located on the reservation in Schurz, NV. All the homes were built over crawl spaces and use wood burning stoves and propane furnaces as heating sources. In most cases, residents used the

wood stoves as the primary heating source and propane as their back-up heater. The cooling system in each home is an evaporative cooler, located on the roof. One home had central air conditioning installed. The homes were manufactured in 1986, transported to the reservation in 1987, and occupied in 1988. Mold was not reported in the homes until July 2002.

Walker River Reservation Findings

1. The Walker River Housing Authority appears to respond promptly to complaints and problems of mold and moisture. Only two of the 15 inspected homes had visible mold. Most of the houses had only past mold and moisture complaints.

2. Bathroom exhaust fans needed replacement in six homes. Consideration should be given to the use of quiet fans, as louder fans may discourage use.

3. Kitchen range hoods are the original units and should be replaced. Five of the inspected homes had problems with their kitchen range hoods. Though the fans vented to the outside, they either did not operate at all or did not operate properly.

4. The Walker River Housing Authority's window replacement program replaces old windows that contribute to moisture from condensation and wind-driven rain with air-tight double-glazed vinyl siding windows. Four of the inspected homes had new windows. This program should be continued.

5. Dryer vent connections in crawl spaces need periodic inspection. Three homes had disconnected dryer vents, which can lead to moisture and mold in affected areas.

6. House depressurization tests following exhaust fan or window replacement are needed to ensure proper ventilation for wood space heaters.

7. Site drainage and gutter systems were poor to non-existent for all inspected houses. While this is not a major concern given the climate, short-term drainage problems and crawl space leakage may occur during occasional heavy rains.

8. Crawl spaces were not a significant source of moisture on this site visit.

General Site Visit Observations

The examples of site visits above indicate the range of physical mold and moisture problems identified. An analysis of these mold and moisture problems was shared with the tribal/TDHE staff during technical assistance and debriefing sessions following the inspections. During the site visits, the inspection teams recognized the following general observations regarding mold and moisture problems in AIAN housing.

Level of Concern Regarding the Mold Problem

The inspection teams found varied levels of concern among residents and TDHE staff about mold in homes, ranging from very little interest (not addressing visible mold problems) to extremely high concern (relocation of households and extensive testing for mold). Concern on most reservations fell somewhere in between these extremes. Based on the wide range of concern and responses, it is critical that TDHEs and residents be given accurate information about the known health effects of mold and the appropriate responses to problems.

Knowledge and Experience in Mold Assessment and Remediation

The knowledge and experience in addressing mold problems also showed significant variability among the TDHEs. While some TDHEs had shown considerable dedication to increasing their knowledge on mold issues, most TDHE staff and residents expressed limited knowledge of and experience in this area. There were cases where TDHEs had secured the assistance of knowledgeable consultants, and other cases where the value of expensive consultants was questionable at best. Some residents had some basic knowledge about mold, while others reiterated inaccuracies they had heard from family members, neighbors, and the media. Both residents and TDHE staff had limited knowledge and experience in the basic and cost-effective methods for cleaning mold. The house inspections, resident interviews, and meetings with TDHE staff confirmed the need for technical assistance and training in assessment, remediation, and prevention of mold and moisture problems for both TDHE staff and residents.

Housing Management and Maintenance Practices

Tribes/TDHEs' local control over NHASDA housing funds has helped spawn diverse management practices and resident services programs. For example, some tribes/TDHEs have decided to spend some of their NAHASDA funds on remediation and repairs of Mutual Help and Turnkey III units conveyed to homeownership. Other tribes/TDHEs have developed strong resident service programs that encourage homeowner responsibilities. The site visits illustrated a wide range of maintenance effectiveness in dealing with mold and moisture problems. The collection and analysis of programmatic information, along with physical housing and site characteristics, would be very helpful in developing mold and moisture indicators, supporting replication of successful program planning strategies for resolving and preventing mold and moisture conditions, and contribute to the formulation of national mold and moisture control standards in AIAN housing. The development of national mold and moisture control standards requires a more thorough and comprehensive study and data collection than what was feasible under this current study.

An example of an innovative program to build the capacity of a TDHE to identify, remediate and prevent mold and moisture problems is the Bois Forte Band of Minnesota Chippewa Tribe's Indoor Air Quality Program (IAQ). Their IAQ Program is funded by a special Environmental Protection Agency (EPA) grant for two years, which began in

April 2002. This program is a collaborative effort involving tribal staff and Federal representatives from the Indian Health Service (IHS), EPA, and HUD. The Bois Forte IAQ Program is one attempt to solve mold and moisture conditions. However, one single model would miss the mark. The key to successful prevention and remediation is a flexible program that allows tribes a range of options developed to address their specific needs.

Positive Response to On-site Technical Assistance

Technical assistance was provided in the form of staff training, on-site instruction of assessments and equipment use, and staff training and debriefing following the housing inspections. These sessions enabled TDHE staff and the inspection teams to engage in valuable dialogue about mold and moisture issues and problems specific to their tribe. These sessions addressed critical issues, such as housing design, sources of mold and moisture problems, strategies for repairs and remediation, and resident education strategies. The TDHE staff and inspection teams worked together on accurately assessing the extent of the mold and moisture problems as well as identifying cost-effective solutions. This on-site training also helped formulate innovative strategies to address prevention of mold problems and improve the capacity of TDHEs to prevent, identify, and remediate specific mold and moisture problems found in their tribal housing stock. Due to the focus on specific tribal mold and moisture problems that emerged from the inspections, tribal participants expressed a high level of satisfaction for the tailored technical assistance and training over a more general format delivered at a regional level.

Follow-up Site Visits

Follow-up site visits would provide valuable information on the implementation of recommendations and action plans regarding mold and moisture problems at the tribal/TDHE level. This information would provide insight on the plans that support or obstruct successful implementation of remediation recommendations for identified mold and moisture problems. Information collected on resident mold and moisture educational and programmatic activities would be valuable in developing long-term prevention strategies.

Database Potential

Data on site and building conditions was tracked throughout the site visit process. Information from the database provides valuable information in examining the nature of the mold and moisture problem. The potential for analysis could be greatly enhanced by tracking additional information regarding demographics, maintenance practices, educational components, and programmatic priorities and activities in future site visits. Enhancements to the methodology and data collection efforts could create an expanded dataset for further analysis, potentially providing insight into programmatic correlations relating to the mold problem. This effort could allow for an examination of the impact of those visits, identification of valuable programmatic changes, and for the improvement of

site visit procedures. Enhancements should only be made to the extent possible within current budget limitations.

High Demand for Additional Site Visits

The 21 mold assessment site visits of tribes with reported mold problems were conducted in a very short period of time. There remains a considerable backlog of tribal requests for site visits and technical assistance. Many requests for site visits are pending, and more interest in mold problems has been generated as tribes, TDHEs, ONAP Area Offices, and national organizations, such as the National American Indian Housing Council, discuss mold issues at their meetings.

CHAPTER 8: REMEDIATION AND TRAINING COST ESTIMATES

Data from site visits to 21 tribes with reported mold problems and canvassing of tribes/TDHEs by the six ONAP Area Offices help illustrate the extent and type of mold and moisture problems found in AIAN tribal/TDHE housing. The canvassing of tribes/TDHEs provided a rough estimate of the extent of mold problems in AIAN tribal/TDHE housing. The site visits to tribes with reported mold problems confirmed that self-reports of mold are strong indicators of actual mold and moisture problems. The inspection teams created a database to organize and analyze the data collected from the site visits. The mold and moisture problems were organized into the following nine categories: site drainage, gutter systems, leaks from exterior, wet basements or crawl spaces, plumbing, bathrooms, exhaust ventilation issues, exterior walls/ceilings, and attics.

As the research indicates, mold and moisture problems in AIAN tribal/TDHE housing require both short-term and long-term strategies to remediate existing problems and prevent future ones. Cost estimates for remediation of mold and moisture problems in existing AIAN tribal/TDHE housing and implementation of a comprehensive prevention and education program for tribes/TDHEs are described in this chapter.

Remediation Cost Estimate

The purpose of this cost estimation is to determine the one-time amount that would be necessary to address the current backlog of mold and moisture problems in the current assisted housing stock. The remediation cost estimate study was derived by combining the results and data from the canvassing of TDHEs to determine the extent of mold and the 21 site visits to tribes with reported mold problems. The following steps describe the remediation cost estimation process in detail:

Step 1: Estimated a Range of Costs by Problem Type or Location.

While many of the same mold and moisture problems were found in different homes and across the 21 tribes site visits, the level of severity varied from house to house. The inspection teams examined and collected data from 175 houses during these 21 visits. Data from 149 of the 175 units were entered into a database. Based on this data, the inspectors made item-by-item estimates to correct each of the problems noted for each unit and also projected the overall remediation costs based on the estimated extent of the mold problem from the tribal canvassing efforts. Cost estimates for correcting each condition were applied uniformly. Later discussions indicated that Alaska has significantly higher construction costs compared with other areas. However, in the absence of a known correction factor, none is applied in the data presented here. The inspectors then calculated minimum, average, and maximum cost estimates by problem category and location for 149 of the housing units inspected.

Site Drainage Problems

Good site drainage is necessary to maintain a dry foundation and ultimately a dry house. Site drainage problems can range from slight to severe. An example of a slight problem would be a localized depression next to the foundation that requires backfilling and a slope away from the foundation. A severe case might involve a house located at the bottom of a hillside that drains large quantities of water at or near the foundation. Severe problems such as this require re-grading the site and creating swales to divert rainwater around the structure. Eighty-one of the 149 houses (54 percent) had some type of site drainage problem. Costs to remediate these problems ranged from:

- Minimum cost: $100
- Average cost: $1,328
- Maximum cost: $10,000

Gutter System Problems

Gutter systems are critical to keeping the ground around a residence dry and preventing water intrusion into the foundation. Minor repairs include replacing or reconnecting downspouts and gutters or installing leaders to divert rainwater well away from the foundation. Complete replacement and installation of a gutter system is the highest cost activity in this category. Gutter system problems were the most common condition identified during site visits, in 128 of the 149 houses, or 86 percent. The range of costs to remediate gutter system problems:

- Minimum cost: $25
- Average cost: $448
- Maximum cost: $1,500

Leaks From Exterior

This category covers water intrusion from roofs, exterior cladding, doors, and windows. Deteriorated shingles, compromised flashing at chimneys, penetrations, or ice dams can cause roof leaks. Minor repairs involve shingle replacement and repairs to flashing; major repairs involve installation of a new roof. Leaks through walls can be caused by poor flashing details at windows and doors and voids in the siding. Walls typically leak under extreme weather conditions if they are in bad disrepair. Of the estimated projects, 31 percent had some exterior leaks. The range of costs to remediate leaks from the exterior:

- Minimum cost: $100
- Average cost: $2,657
- Maximum cost: $7,500

Wet Basements or Crawl Spaces

Several factors can contribute to below-grade moisture problems: poor site drainage, poor or nonexistent rainwater management, or high water tables. Occasionally residents contribute to a basement moisture problem with activities that introduce moisture into the air— hanging clothes to dry indoors or excessive basement clutter (prevents adequate air circulation). This cost category includes a broad range of remediation activities including:

- Minor mold remediation – repair of interior finishes, installation of crawl space vapor barrier, and sealing ductwork
- Moderate remediation – installation of sump pit and sump pump, installation of shelves to reduce clutter, and water heater replacement
- Major remediation – installation of interior drain system, exterior excavation and waterproofing foundation

Basements and crawl spaces were frequently wet, with more than half (52 percent) of the houses needing remediation. The range of costs to remediate wet basement or crawl spaces:

- Minimum cost: $100
- Average cost: $1,793
- Maximum cost: $20,000

Plumbing Problems

Plumbing problems primarily involve leaks in either the supply or drain lines of plumbing fixtures. These leaks typically manifest in damage and mold contamination in kitchen and sink cabinets. Included in this category are poorly sealed toilets, leaky exterior hose bibs, leaking washing machines, and condensation on toilet tanks and uninsulated water supply lines. Plumbing problems were identified in 57 houses (38 percent). The range of costs to repair plumbing problems:

- Minimum cost: $100
- Average cost: $393
- Maximum cost: $1,500

Bathroom Problems

By nature of their function, bathrooms are wet rooms. Moisture problems in bathrooms (other than plumbing leaks) fall into two categories: spills, splash-up and leaks in tub and shower surrounds, and general mold contamination on ceilings and walls from dampness and moisture between showers

The first category of problems is particularly common when bathroom walls are finished with gypsum wallboard rather than a water-impervious surface. The space behind the toilet, adjacent to the shower, is the most common area exhibiting water damage. When a tub and shower surround deteriorates and is not maintained, considerable damage and mold contamination can occur in the adjoining walls.

General mold on ceilings and walls is often associated with poor localized ventilation and overcrowded conditions. Bathroom problems occurred in 78 of 149 houses or 52 percent. Remediation costs vary depending upon the severity of the problem, from minor drywall repair and mold removal to replacement of shower surrounds.

- Minimum cost: $100
- Average cost: $668
- Maximum cost: $3,500

Exhaust Ventilation Problems

Some areas in a house are naturally high-moisture areas. Local exhaust ventilation for bathrooms, kitchen ranges, and clothes dryers reduces the overall moisture in a house by venting the moisture directly to the exterior. Poor local exhaust ventilation in bathrooms created severe mold contamination problems in several cases. Inspectors identified a few new houses with relatively airtight construction. Whole house ventilation is recommended in these cases. This is typically not a concern with older houses. Sixty-eight percent of the houses had nonexistent, inoperable, or poorly functioning exhaust fans. Treatment can vary from repairing exhaust fan ductwork to installing new fans and controls.

- Minimum cost: $50
- Average cost: $394
- Maximum cost: $2,300

Exterior Wall and Ceiling Problems

Exterior wall and ceiling problems come from winter condensation on the interior side of an exterior wall and its ceiling surfaces. The most common condensation location is at the wall–ceiling juncture of exterior walls. This results from inadequate insulation, cold exterior airflows, and corner geometry. Increasing the amount of insulation at the wall–ceiling junction can mitigate mold formation at this location, as can maintaining a reasonably low level of interior humidity. Exterior walls in closets are another common area for condensation problems. Thirty-two percent of the houses exhibited some type of condensation problem.

- Minimum cost: $100
- Average cost: $1,571
- Maximum cost: $3,000

Attic Problems

Attic problems typically stem from moisture inside the living space migrating to the attic. Attic moisture can also be caused by bathroom and kitchen exhaust fans venting into the attic rather than to the exterior. Moisture damage is typically on the roof framing and sheathing, though in severe cases it can reach ceilings and compromise attic insulation. Poorly insulated attic hatches were identified, and are included in this category. A small percentage of the inspected houses (17 percent) had mold problems in the attic.

- Minimum cost: $100
- Average cost: $516
- Maximum cost: $2,000

The data collected from the 149 houses included categorization of costs by problem or location and frequency of occurrence. The inspectors also prioritized the importance of problems by type. Table 18 summarizes the estimates based on the data collected.

Table 18

Cost Estimate by Problem Category

Problem Type or Location	Priority of Problem Type	Houses in 149 Unit Data Base with Problems		Cost per Unit to Remediate		
		# of Units *	% of Units	Minimum	Average	Maximum
Site Drainage	Very High	81	54%	100	1,328	10,000
Wet Basement or Crawl Space	Very High	77	52%	100	1,793	20,000
Bathroom	High	78	52%	100	668	3,500
Exterior Wall/Ceiling	High	48	32%	100	1,571	3,000
Gutter System	High	128	86%	25	448	1,500
Leaks from Exterior	High	46	31%	100	2,657	7,500
Plumbing	High	57	38%	100	393	1,500
Attic	Medium	25	17%	100	516	2,000
Exhaust Ventilation	Medium	102	68%	50	394	2,300

Source: Site Visit Database

* Multiple problems may exist in each home.

Step 2: Consolidated the estimated problem/location costs to a total estimated cost for remediation by unit for each of the 149 units in the database.

Remediation Cost by Housing Unit

The inspectors estimated the cost of remediation for all the identified problems by unit. These data include costs for gut rehabilitation, new units, and individual repairs. Remediation for the majority of the houses (53.7%) were estimated at $3,000 or less, with half of that total featuring remediation costs less than $1,000. The average estimated cost for all 149 houses was $5,635.

Step 3: Assigned the estimated remediation cost for each unit to a cost category ranging in increments of $1,000 from $0 to greater than $20,000.

Each unit was tallied under its appropriate cost category. Units assigned a cost of greater than $20,000 require substantial rehabilitation.

Step 4: Created a category for total unit replacement.

An additional cost category, total house unit replacement, was created. Some houses were abandoned and replaced owing to deep-seated concerns over the extent of mold contamination. The damage to the units after abandonment was so severe that it was not possible to determine the actual condition of the houses when occupied or to make recommendations for rehabilitation. These abandoned houses were not included in the database. However, three of the 149 units (2 percent) in the database were so dilapidated that replacement would be less expensive than remediation. Conditions in these three houses included not only mold infestation, but also other unsafe or unsanitary conditions (combustion safety issues, severe structural faults, electrical safety). Replacement is recommended over remediation when the condition of the housing unit does not justify the cost to rehabilitate it. Mold alone is insufficient justification for housing unit replacement. All visible mold, caused by design, construction, or maintenance shortcomings, can be cleaned or removed and the moisture conditions addressed without replacing the house. The condition of the site and the foundation often plays a major role in the moisture conditions leading to the abandonment of a housing unit. Unit replacement often requires selection and development of a different site or a complete re-grading of the existing site.

Step 5: Apply the cost estimates from the 149-unit database to the total estimated/projected units with mold problems as developed in Table 19.

Program Cost Summary

Table 19 projects a total cost for remediation of housing units. The ratios and costs developed from the 149-unit database (see Table 18) were applied to the projected total of 10,348,529 units with mold (see Table 14). Inspectors tabulated the estimated cost to remediate the identified problems in each of the houses. The number of houses falling within a cost range was tabulated and an average for that range was calculated. These percentages and costs were applied to the 109,348,529 units projected to have mold problems as derived at Table 14.

Table 19

Projected Remediation Costs

Information from Site Visit Database				Table 14 Estimated # of Houses	Total Program Cost ($)
Cost Category	Number of Houses	Percent of houses estimated	Average Category Cost ($)		
0 - 1,000	41	27.5%	570	2,621	1,493,970
1,000 - 2,000	20	13.4%	1,490	1,278	1,904,220
2,000 - 3,000	19	12.8%	2,461	1,215	2,990,115
3,000 - 4,000	17	11.4%	3,600	1,087	3,913,200
4,000 - 5,000	7	4.7%	4,364	448	1,955,072
5,000 - 6,000	6	4.0%	5,450	384	2,092,800
6,000 - 7,000	5	3.4%	6,150	320	1,968,000
7,000 - 8,000	7	4.7%	7,464	448	3,343,872
8,000 - 9,000	2	1.3%	8,575	128	1,097,600
9,000 - 10,000	4	2.7%	9,488	256	2,428,928
10,000 - 15,000	9	6.0%	11,700	576	6,739,200
15,000 - 20,000	3	2.0%	17,567	192	3,372,864
> 20,000	6	4.0%	25,692	384	9,865,728
Replacement	3	2.0%	177,699	192	34,118,208
Total	149	100.0%		9,529	77,283,777

Source: Site Visit Data Base and 2003 Canvass of TDHEs

Figures in the column Total Program Cost (Table 19) outline the estimated time and materials costs only, exclusive of administrative costs. Costs for work in Alaska should be estimated higher than shown here. Total direct costs (time and materials) for the remediation of moisture and mold problems are estimated at $77.3 million. This figure represents the estimated cost for trained, experienced remediation crews to remove and clean mold and correct the underlying cause of the moisture problems.

Mold Training and Education Program

The twenty-one21 site visits clearly illustrated the need to provide training and education to tribes, TDHEs, and residents on how to identify, prevent, and remediate mold and moisture conditions in their housing. A long-term strategy that addresses the root causes and seeks to prevent future problems can only be accomplished at the local level. Prevention of future problems will cost far less than further remediation. The goal is to fully develop the capacity of local housing entities to prevent moisture problems and promptly remediate problems.

Bois Forte Band of Minnesota Chippewa Tribe

A recent example of an innovative program is the Bois Forte Band of Minnesota Chippewa Tribe's Indoor Air Quality Program (IAQ). The Bois Forte Reservation is located in Nett Lake, Minnesota. Their IAQ Program is funded by a special Environmental Protection Agency (EPA) grant for two years that began in April 2002.

During the summer of 2000, several homes on the Bois Forte Reservation were inspected and found to contain various levels of mold. A team of tribal staff and Federal representatives from the Indian Health Service (IHS), EPA, and HUD assessed the problem and proposed solutions. A total of nine families were relocated because of the magnitude of the problems in their homes and the medical histories of the occupants. The Bois Forte Band successfully conducted a remediation project including mold abatement and moisture and water intrusion control that was completed in April 2001 on some of the homes.

The Bois Forte IAQ Program funds a staff position, purchase of necessary equipment, and other training and mold assessment program costs. The project provides home investigations, public education and outreach activities, and education to residents regarding their role in remediation, planning, and design. The Bois Forte IAQ Project staff person helps the TDHE to build its capacity to implement good mold and moisture practices, make accurate assessments of building problems, and develop appropriate remediation and repairs. The annual cost for the Bois Forte IAQ Program is $105,000.

Mold Training and Education Program Cost Estimate

Using the Bois Forte Band IAQ Program as a model, the cost of implementing a similar program for the 255 participating tribes in the IHBG Block Grant Program with Formula Current Assisted Stock (FCAS) under management has been estimated below. To make the estimates, the tribes were categorized by size, i.e. small, medium, and large. In the July 5, 2002 Federal Register; Announcing Indian Housing Block Grant Formula Allocation, Notice of Intent to Establish Negotiated Rulemaking Committee, small, medium, and large tribes are defined as follows:

1. Small Tribe: Tribe with less than 250 units under management
2. Medium Tribe: Tribe with 250-00 units under management
3. Large Tribe: Tribe with more than 500 units under management.

The Bois Forte Indoor Air Quality Program provides a framework for program development and cost estimation. The estimated program costs for training and education on reservations are based on costs of the Bois Forte Reservation IAQ Program. The Bois Forte Reservation has 94 FCAS units under management and is considered a small tribe. Additional increments have been added for the medium and large size tribes based on prorated program cost categories from the Bois Forte IAQ Program. Based on this estimated model, the 255 tribes would need a total of $13.4 million per year to fund a

training and education program that is similar to the Bois Forte IAQ Program. Table 20 below provides the estimation for the training and education program costs for all tribes.

Table 20
Estimated Training Program Cost*

Bois Forte Indoor Air Quality Project Budget		Training Cost Only by Size of Tribe				
Training and Assessments		**Small**	**Med**	**Large**	**> 1,000**	**Total**
Salaries & Benefits	55,000	27,500	41,300	55,000	60,500	
Travel	10,000	5,000	7,500	10,000	11,000	
Equipment	9,000	2,300	2,300	2,300	2,300	
Other Program Costs						
Supplies	1,860	900	1,400	1,900	2,000	
Training Workshops	1,000	1,000	1,300	1,500	1,600	
Conference Fees	300	0	0	0	0	
Mailing Distribution Costs	300	200	200	300	300	
Contractual Cost	7,000	0	0	0	0	
Internet	500	300	300	300	300	
Sample Shipping Costs	500	0	0	0	0	
Subtotal Other Program Costs	11,460	2,400	3,200	4,000	4,200	
Indirect Costs [i]	19,540	7,440	10,900	10,900	10,900	
Cost for a tribe	105,000	44,640	65,200	82,200	88,900	
Number of Tribes in Database		185	41	18	11	255
Total Cost		**8,258,400**	**2,673,200**	**1,479,600**	**977,900**	**13,389,100**

Source: Bois Forte Budget

* Bois Forte indirect cost rate = 22.3%; estimated training program indirect rate = 20% per Program Cost Summary

A training and education program would empower tribes by helping them develop their capacity to conduct assessments, train staff and residents, and take preventive steps for averting mold damage to homes and people. This education and training program is recommended for three years initially. However, the timeline will emphasize more of the site visits at the beginning of the three year period to provide technical assistance for implementing their own education and training program time that build the tribes' own capacity to conduct assessments, and train and educate their own staff and residents. Support, e.g., technical assistance and mold assessment site visits, for this training and education would be needed to help implement this program. The current contract for mold assessment and technical assistance site visits through ONAP provides for only a few more. After those site visits, the mold assessments through ONAP will soon end.

Finally, AIAN tribal/TDHE communities are culturally, socially, economically, and geographically diverse. The Bois Forte IAQ Program is one attempt to solve mold and moisture conditions. However, one single program model would miss the mark. The key to successful prevention and remediation is a flexible program that allows tribes a diversity of options that would be developed to address their specific needs.

Total Remediation and Training Cost Estimates

Physical remediation of the property is only one part of an effective total remediation program. While the $77.3 million estimate for addressing existing mold and moisture conditions covers a range of anticipated remediation and repair costs, it does not address the need for long-term solutions for the prevention of mold and moisture problems. The $77.3 million is a one-time investment to remediate the existing mold problem.

A long-term solution should include prevention and education programs and a program to empower the tribes to administer their own prevention and maintenance programs. A recommended long term solution includes one time overall remediation, technical assistance to continue to assess the mold and moisture problems, and development of tribal capacity to administer their own assessment and remediation programs as well as resident training. A program that provides site visits and on-site technical assistance will help tribes develop their own training programs with the capacity to assess mold and moisture problems, determine appropriate remediation efforts as well as provide occupant education on prevention and maintenance. Ideally, the tribes will also have the resources to include technical expertise in design and site locations for new developments.

The $77.3 million cost estimate for remediation and $13.4 million estimate for a tribal training program bring the initial first year cost for a remediation and training program to $90.7 million. Additional costs would include the cost for on-going maintenance and prevention and technical assistance to empower tribes to expand their capacity to assess mold and moisture problems. In addition, a long term strategy would include an annual estimated training cost of $13.4 million per year for another two years. The three year training program would be an estimated total of $40.2 million.

CHAPTER 9: FINDINGS AND RECOMMENDATIONS

Findings are based on the 2000 U.S. Census and tribal data collected, a review of health and scientific literature regarding mold, the canvass of tribal communities conducted by the Office of Native American Programs (ONAP) Area Offices, and the 21 site visits to tribes with reported mold problems. Recommendations are based on the findings, as well as the knowledge and experience of inspection teams and other experts in housing construction and policy in American Indian and Alaska Native (AIAN) lands.

Mold and moisture conditions affect both existing housing and units in development. Remediation and prevention are the two keys to long-term abatement. To address the primary causes of mold problems and to prevent future moisture conditions, any long-term mold abatement strategy must combine education and training with remediation.

Mold should be corrected, even if the health condition of the occupants is not a concern. The moisture conditions that lead to mold may, if allowed to persist, lead to the growth of fungi that can cause structural damage to wood-frame buildings. Sites of active mold growth should be corrected by identifying and correcting the underlying moisture problem, and through safe and effective cleaning or removal of the affected surfaces.

While current scientific evidence does not support the conclusion that occupant health is adversely affected by inhaled mycotoxins in home, school, or office environments, the literature does indicate that individuals with suppressed immune systems and allergies can be affected. Additional research is under way that may provide more definitive information on the relationship between mold in the environment and health problems.

The principal form of mold investigation relies on visual inspections and physical evidence, along with other physical measurements, such as surface temperature, wood moisture content, and ventilation rates. Techniques for sampling air and surfaces for mold are available, but these techniques are often applied in ways that lack statistical reliability. In these instances, sampling air may lead to detrimental effects on individuals, tribes, and tribal finances.

Findings

This report presents eight major findings on the extent of the mold problem in tribal/Tribally Designated Housing Entities (TDHE) housing.

1. **No definitive evidence that inhaled mold toxins have generally adversely affected human health.**

The review of current literature on the health effects of mold found that inhaled mold toxins in home, school, or office have generally not adversely affected human health. However, people with suppressed immune systems and allergies may be more sensitive to mold, as mold can trigger allergic symptoms. Mold infections are a concern in healthcare environments, but not to any significant extent in residences.

The Indian Health Service "Position Statement" on mold and the American College of Occupational and Environmental Health support the position that mold is not dangerous to most people. However, some occupants believe mold in their homes made them ill; others were removed from their homes and relocated for health reasons. There have been stories in the media that promote the idea that mold is a serious health threat to everyone. These perceptions are often out of proportion to the actual extent and impact of mold.

2. Mold conditions found in 15 percent of housing units.

During a six-week period, 20 percent of the tribes, representing 43,532 housing units (65 percent) of the total units currently under management responded to the canvassing. Canvassing results found that 6,743 units (15 percent) had resident-reported mold conditions. (The housing units canvassed excluded those that are privately or tribally owned, sponsored by the Bureau of Indian Affairs, or newly constructed under NAHASDA.)

3. Self-reports of mold are reliable indicators of actual mold and moisture problems.

Resident reports of mold have been found to be highly reliable indicators of mold and moisture conditions by our inspection teams. From August 2002 through June 2003, inspection teams trained in mold identification and remediation investigated 175 units during 21 site visits to tribes with reported mold problems in their housing units. Of the units investigated, 62 percent had visible mold and 85 percent had identifiable moisture problems.

4. Mold and moisture problems are commonly caused by physical conditions that can be categorized into nine areas.

Based on the visits to 21 tribes with reported mold problems, the research team identified the most common types of mold and moisture problems: 1) site drainage, 2) gutter systems, 3) leaks from the exterior, 4) wet basements or crawl spaces, 5) plumbing, 6) bathrooms, 7) exhaust ventilation, 8) exterior walls or ceilings, 9) and attic. The moisture problems were associated with either a bulk water source, such as roof leaks, basement leaks, plumbing leaks or flooded crawl spaces, or with condensation, where high indoor humidity encountered chilled building surfaces.

5. There are four root causes that result in moisture problems, and these root causes define the points of intervention for developing long-term solutions.

The root causes of moisture problems and subsequent mold contamination are: 1) design and construction issues, 2) TDHE maintenance, 3) occupant maintenance and practices, and 4) overcrowding and low-income issues.

6. Overcrowding is a factor in mold and moisture conditions.

The shortage of housing combined with limited household resources has resulted in overcrowding in tribe/TDHE housing. Overcrowding multiplies the generation of moisture from human sources, which contributes to elevated interior moisture loads, and ultimately (if other conditions are in place) can lead to mold contamination from condensation. Overcrowding contributes to rapid deterioration of housing materials and equipment, which can also lead to moisture problems and mold. Overcrowding increases storage problems. With more personal possessions inside the house, closets are overfilled, objects are likely to be placed against exterior walls creating cold spots for condensation, and contributing to mold.

ONAP recently instituted a special initiative, with Area Offices collaborating with tribes/TDHEs to identify and develop strategies to reduce overcrowding. These short and long-term strategies include leveraging diverse resources, developing tribal economies, comprehensive homeownership counseling, and new housing production. These strategies should eventually lead to more functional housing and less overcrowding.

The strategies will require some modifications as they are implemented. Nonetheless, a process is under way, which for the first time looks directly at overcrowding in tribal/TDHE housing. Resolving mold and moisture problems is one of many reasons ONAP should address overcrowding.

7. Wide range of concern, knowledge, and programmatic approach.

During the site visits to 21 tribes with reported mold problems, the inspection teams found varied levels of concern among residents and TDHE staff about mold in homes. Concern ranged from very little interest (not addressing visible mold problems) to extremely high concern (relocation of households and extensive testing for mold). As expected, knowledge and experience in addressing mold problems also showed significant variability amongst the TDHEs, which in turn was reflected in their management, resident services, educational and maintenance programs. Maintenance programming, in particular, showed a wide range of effectiveness in dealing with mold and moisture problems.

8. Remediation and training are needed to support tribal/TDHE remediation and prevention efforts.

This study includes a cost estimate to determine the one time amount that would be necessary to address the mold and moisture problem in the impacted units. The preliminary estimate for the remediation of mold and moisture problems (time and material) is $77.3 million. This figure represents the estimated cost for trained, experienced remediation crews to remove and clean mold and correct the underlying cause of the moisture problem. To complement the physical remediation efforts, training for tribes/TDHEs are needed to strengthen their capacity to develop and implement

effective assessment, maintenance, remediation, and educational programs to address mold and moisture conditions. The preliminary cost estimate for a comprehensive Mold Training and Education Program is $13.4 million annually for a three year period. The total preliminary cost estimate for remediation and a tribal training program is $90.7 million.

Recommendations

The following recommendations are aimed at addressing mold and moisture problems in present and future housing stock on tribal lands.

1. Develop a short-term strategy for existing mold problems and a long-term strategy for the prevention and treatment of future problems.

A short-term strategy is required to provide resources for addressing existing moisture and mold problems, primarily focused on current physical conditions in housing. Preliminary cost analysis conducted as a part of this study estimates that $77.3 million is needed to remediate the existing mold and moisture problem in AIAN tribal/TDHE housing. Tribal housing professionals have reported mold remediation costs could be as high as $25,000 per unit in some cases, with the amount dependent upon the conditions and the sources of the mold and moisture problems. A long-term strategy should be developed to address the root causes of mold and moisture problems. Such a long-term strategy will only be successful when fully implemented at the local level. The goal of this strategy could be to develop the capacity of the local TDHEs to prevent moisture problems and promptly mitigate problems when they arise. A preliminary cost analysis of such a program revealed that forecasts an annual allocation of $13.4 million for three years is would be needed to implement a comprehensive Mold Training and Education program. The combined preliminary estimate for both remediation and training is $90.7 million. However, additional research and analysis would provide a more accurate cost estimate of the actual program needs.

An initiative that addresses both short-term and long-term needs could include:

- A program of continuing on-site technical assistance
- On-site training programs focused on assessment and remediation
- Development of housing management and resident education programs

Due to the cultural, social, economic, and geographic diversity of AIAN tribal communities, a flexible program that allows tribes diverse options to address their specific needs is needed to ensure successful prevention and remediation of mold and moisture problems.

2. Enhance site visit research and database.

The 21 site visits to tribes with reported mold problems provided technical assistance and on-site skills building to tribe/TDHE staff and tribal housing residents. The site visits

enabled the research team to collect valuable information and develop a database reflecting the characteristics, extent, and physical conditions leading to mold and moisture problems in tribal housing. There is much yet to be learned about the extent and parameters of the mold problem. A program of well-designed and integrated research studies could provide a more thorough understanding of the characteristics of the problem and the optimal approaches to address it. Enhancements to the methodology and data collection efforts could create an expanded dataset for further analysis, potentially providing insight into programmatic correlations relating to the mold problem. Additional site visits to tribes with reported mold problems are also needed to address the increased demand by the tribes and to gather additional data, train tribal/TDHE housing staff to conduct assessments for mold and serve as a support to the training and education program.

3. Investigate the creation of a national housing design clearinghouse.

To enhance planning and design of new housing, housing design resources could be provided through a national housing design clearinghouse. This national clearinghouse could help avert the cycle of moisture problems that result from poor design and site selection. Through the national clearinghouse, information and technical expertise would be available to build tribes' capacity for tasks such as reviewing plans for site design and grading, mechanical and ventilation systems, and building envelope. Tribal members and TDHE staff would be trained to prevent mold and moisture problems, through proper installation of ventilation and mechanical systems, for example. The research team has had preliminary discussions with both Indian Health Service (IHS) and the Federal Emergency Management Agency (FEMA) about the benefits of coordinating site design and plan checks and land use plans as a prevention measure against mold and moisture problems in AIAN tribal/TDHE housing.

4. Partner with Federal, state and local agencies and organizations.

Collaboration among tribal governments with Federal agencies and private sector organizations, such as foundations, could address the mold and moisture conditions on the reservations. These collaborations can help bring interested parties together to help resolve mold and moisture problems.

For example, collaboration with the Federal Emergency Management Agency (FEMA) might focus on site design and drainage, one of the nine problem categories. FEMA is mapping flood plain areas on the reservations. Identification and mapping of flood plains on tribal lands can be invaluable in new home site-selection decisions, preventing structures from being built in areas susceptible to floods. High water tables and flooding have been identified as problems contributing to mold on some tribal lands.

Collaboration with the Division of Environment Health Services (DEHS) of the Indian Health Service can be mutually beneficial. The primary role of DEHS is to provide technical assistance to tribes on environmental health issues. Mold and moisture conditions have become an important issue to DEHS and it is committed to working

closely with the tribes to address it. IHS recently released a "Position Statement" on the potential health effects of mold (see Appendix C). DEHS staff convened regional mold prevention and remediation training workshops for tribal governments and TDHEs. They have also provided leadership in developing presentations and convening stakeholder meetings at the regional level to keep abreast of mold problems and promote collaborative strategies.

The mold problem in tribal/TDHE housing is complex and involves many Federal agencies and programs (see Appendix E). Many Federal agencies have been collecting data, producing materials, conducting training seminars, funding pilot projects, providing site visits and technical assistance, evaluating and treating health concerns that may be related to mold, and holding interagency meetings. A Federal interagency working group could act to coordinate these activities.

Along with these and other Federal agencies, partnerships should be forged with homeowners and other occupants, community leaders, community-based health and human service organizations, public safety agencies, and schools and colleges. The mold problem is important to many American Indian and Alaska Native people who live and work on tribal lands in the ONAP Area Office jurisdictions. Even if the health effects of mold may not prove to be a serious problem for most these residents, their questions and concerns should be sought out, heard, and discussed. These residents should have the opportunity to express their perceptions and personal views on mold issues. They should also receive an appropriate response.

Conclusion

This report to Congress presents evidence confirming mold contamination and moisture problems in tribal/TDHE housing although it makes no definitive link to health problems related to mold for most people. The report supports tribal concerns to solve these problems and improve the safety and quality of their housing stock. While initial research has confirmed these findings, more site visits should be conducted to further assess mold and moisture problems and begin engaging tribal members in mold prevention, identification and remediation efforts. Demand for and support of a comprehensive, flexible, and well-funded mold remediation, training, and housing rehabilitation program appears to be gaining support and momentum at the tribal level and nationally. The funding of a nationwide mold prevention, remediation and capacity building program would help eliminate longstanding mold and moisture problems and prevent costly construction errors in future housing developments. By implementing a comprehensive training and education program for tribes/TDHEs, tribes can strengthen their capacity to address local housing problems and provide quality homes for their members. The development of a national housing design clearinghouse will help foster collaboration and sharing of best practices and innovative designs and construction techniques amongst tribes/TDHEs. HUD, along with other Federal agencies, has the opportunity to successfully address mold concerns by building on model programs and engaging tribal leaders, TDHEs, and housing residents in an ongoing dialogue to inform and inspire their own skills development and empowerment for mold prevention and remediation.

APPENDICES

APPENDIX A: REFERENCES

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APPENDIX B: CLARIFYING COMMON MISPERCEPTIONS ABOUT MOLD

Common Misperceptions About Mold
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The following are common misperceptions about mold, specifically addressing how they affect human health and physical housing conditions and about testing and remediating mold. Many of these perceptions were heard during our visits to the various tribes and reservations. We hope to allay people's fears and misperceptions about mold and clarify basic facts about mold.

1. COMMON HEALTH MISPERCEPTIONS

Perception: *"Mold is toxic."*
Reality check: Mold may be poisonous if it is eaten, otherwise mold is not toxic. (The words "poisonous" and "toxic" are synonymous.) After a long study of all the scientific and medical literature regarding the toxicity of airborne mold, the National College of Occupational and Environmental Medicine concluded that airborne mold is not toxic to humans in the concentrations found in homes, schools and offices. People with allergies and asthma may have reactions around high concentrations of mold, however.

Perception: *"Stachybotrys chartarum is a toxic mold"*
Reality check: Stachybotrys chartarum is a very common mold, capable of being found in almost any building. All molds are capable, under certain conditions, of producing chemicals (mycotoxins) to compete with other microorganisms such as bacteria or other molds. Presence of *S. chartarum* does not indicate presence of a toxin. The research that started the "mold crisis", a paper that purported to show that *S. chartarum* caused infant lung disorders (AIPH) in Cleveland, has been discredited by the CDC. Their conclusion about *S. chartarum* is: "the evidence from these studies was not of sufficient quality to support an association between S. chartarum and AIPH." *S. chartarum* should be cleaned up like any other mold.

Perception: *"Something in my house is making me sick. It must be the mold."*
Reality check: People with health disorders require health care. Doctors and health professionals are trained to conduct a diagnosis from symptoms. For most disorders, airborne mold spore concentration is not a likely cause. For allergies, mold may be one of a half dozen or so principal triggering factors. There are many human conditions without known causes, and many agents in the environment without known effects. It is in human nature to speculate on how those might be considered together. The desire for simple explanations linking environment to condition underpins "the mold problem" in housing. Unfortunately, the desire for such links exceeds the ability of the science and health communities to provide them.

2. COMMON PHYSICAL MISPERCEPTIONS

Perception: *"Now that I found mold growing on a wall, even if I fix it up, my home will have a mold stigma, and it will have a lower property value."*
Reality check: Mold growth on walls is very common. Everyone has some mold growth from time to time. Small areas can simply be scrubbed clean. Large areas of gypsum wallboard can be replaced. The underlying moisture problem must be corrected. Once all this is done, there should be no real or perceived penalty. This is normal home maintenance, and it demonstrates that the owner meets high homeownership standards.

Perception: *"I have mold and that means that somebody screwed up, and should be punished."*
Reality check: Some occurrences of mold are natural and unavoidable, for example the buildup of spore-containing dust in building cavities. Some occurrences of mold come from mistakes by builders, remodelers or homeowners. There is room for improvement in everyone's practice. We should all focus on the improvement, not the punishment.

Perception: *"I rent, and if I tell the landlord about this mold problem, he'll kick me out."*
Reality check: All water problems and mold problems must be reported. A tenant cannot be kicked out for a water or mold problem. A tenant can be kicked out for failure to report a major problem. A tenant must keep property clean and in good order.

3. COMMON MISPERCEPTIONS ABOUT SAMPLING

Perception: *"They found mold in my home."*
Reality check: Indoor environments are not sterile. All indoor environments contain mold spores. The techniques for counting mold spores are statistically crude, so the quantity of mold that is found is not likely to be replicated in a follow-up measurement. No interpretation or conclusion can be drawn from a single mold measurement, or from a small number of measurements.

Perception: *"My house seems okay, but I'm afraid of what's behind the wall."*
Reality check: Building cavities naturally have very high concentrations of mold spores. Building cavities are natural accumulators of dry spores and dry mold material. Houses normally subtract some of the mold spores and mold material from the outdoor air, and the building cavity is where these products end up. If they did not accumulate in the cavities, then the indoor concentrations that we breathe would be much higher. Mold may also grow in wet cavities, and that is not desirable.

Perception: *"The results came back showing I have Stachybotrys and other mold contaminants."*
Reality check: 1) All homes have mold in the air and on surfaces and in cavities. 2) The "results" are lab results—numbers generated by the sample. They may or may not represent the environment being considered. 3) There is no accepted baseline that distinguishes acceptable from unacceptable numbers. 4) The list of possible errors and

biases in sampling is a long list, and it affects the confidence one should have in the results.

4. COMMON MISPERCEPTIONS ABOUT REMEDIATION

Perception: *"I need to call a remediation expert."*
Reality check: Almost all of the damage to homes that was seen during our site visits was small in area, and requires only Level I cleaning according to the New York City Guidelines. Level I cleaning can be done with no special products, with no special protection, and with the occupants remaining in the house. The only cases that may be more severe than Level I that we saw during our visits involved 1) long-term house vacancy, 2) prolonged flooding of crawl spaces, and 3) severe overcrowding and clutter.

Perception: *"The family has to move out."*
Reality check: Health authorities must make any decisions regarding relocation of individuals or families. Housing Authorities (HA) should adopt a policy of cleaning (and remediating if necessary) any home that has been severely affected by mold. If the HA fails to take action, the home may remain abandoned, and may be vandalized or burned. Any relocation should be accompanied by an effort for prompt remediation and re-occupancy of the dwelling.

APPENDIX C: INDIAN HEALTH SERVICE POSITION PAPER ON MOLD

Introduction

This paper states the Indian Health Services (IHS) Division of Environmental Health Services (DEHS) position on environmental health officers' (EHO) scope of responsibilities regarding mold issues in home and HIS facilities.

EHOs in several IHS Areas have been spending increased time and resources on mold issues within Indian homes. Although the IHS has a professional obligation to respond to these concerns, scientifically valid literature does not substantiate an increased priority on mold issues. This paper clarifies the mold issue and defines the problem in terms of actual health risks rather than perceived risks. Providing a written statement defining the scope of responsibilities regarding mold issues sets limits on time and resources committed to these activities so that they are proportionate to the level of health risk. This will benefit American Indians and Alaska Natives by reserving resources for environmental health issues whose health risks have been confirmed by statistically significant data. This paper supports a continued yet limited EHO response to residential mold issues, which concentrates on prevention, remediation, and education rather than environmental sampling and health assessments.

Background

Fungi make up a large taxonomic kingdom called Myceteae, which includes molds, mushrooms, smuts, and rusts.[1] Fungi live in nearly all environments: indoors, outdoors, and on or within other living creatures, including humans. Because the scope of this paper deals with mold contamination within tribal homes and IHS facilities, it will concentrate only on those molds that, under proper conditions, thrive inside buildings.

Mold, the most common type of fungus, includes thousands of different species. Indoor molds alone are estimated to include 1,000 species. Mold colonies grow as long, tangled cellular masses, and are usually pigmented. Since all fungi, including molds, lack chlorophyll, they are heterotrophic, and therefore must obtain nutrients from organic material. In addition to organic nutrients, molds also must have a water source for survival.[2,3]

Through reproduction processes, molds create tiny spores that are easily suspended in air.[1,2] When mold spores encounter moisture, they may begin growing and digesting organic material. When excessive moisture or water accumulates indoors, mold growth will often occur, particularly if the moisture problem remains undiscovered or is not addressed. An attempt to eliminate all molds and mold spores in the indoor environment is not practical. Only by controlling moisture can one successfully control indoor mold growth.[4]

Health Risks

Mold spores, fragments, and mycotoxins have the potential to cause illness. Three categories of illness are of concern regarding mold exposure: allergic response, infection, and toxigenic effect of mycotoxins. The current body of scientific knowledge regarding health effects of mold suggests that the presence of mold in buildings constitutes a minimal health risk to the general population.[1,5,6] However, mold has been shown to be a health risk to the following susceptible populations: the very young; the elderly; those with existing respiratory problems, such as asthmatics; and the immunocompromised, such as AIDS patients and those who are undergoing chemotherapy. Because of potential health risks, no matter how minimal, and because mold damages building materials, mold growth should be prevented and eliminated.[6] Furthermore, individuals who feel that their health is being affected from exposure to mold should be encouraged to seek medical attention and advice.

Allergic Responses

It is believed that all fungi produce allergenic substances; however, relatively few have been tested for allergenicity. Fungal allergies are common: 10% of the general population and 40% of asthmatic patients are allergic to fungi.[6] While serious allergic reactions to mold can occur, such as hypersensitivity pneumonitis (HP), these reactions have been shown to occur only at very high occupational concentrations of fungal spores and fragments.[5] These concentrations occur at levels several orders of magnitude higher than typical levels found in the indoor environment.[1]

The most commonly reported health effect caused from mold exposure is immediate hypersensitivity. This is a Type I, IgE –mediated sensitization reaction whose clinical manifestations can vary from urticarial skin reactions (wheals and flares) to signs of hay fever (rhinitis and conjunctivitis), and can be a precursor to asthma attacks among asthmatics.[5,7] In its 2000 report "Clearing the Air: Asthma and Indoor Air Exposures," the Institute of Medicine (IOM) concluded that there is sufficient evidence of an association between exposure to mold and exacerbations of asthma, but there is not adequate evidence that molds cause people to become asthmatic.[8]

Infections

Serious infections from molds are a concern only for severely immunocompromised individuals. Precautions should be taken to eliminate amplification factors, such as excessive moisture, from their living areas. Also, molds associated with superficial fungal infections, such as athlete's foot (*tinea pedis*) and so forth, can be found as indoor mold. However, existing literature does not warrant recommendations relative to home, school, or office exposures in patients with superficial fungal infections.[5]

Toxigenic Effects

Most of the information on health effects from mycotoxins comes from human ingestion data and animal exposures. To date, however, no study in humans has conclusively linked mycotoxin inhalation exposure to any serious health effect. While there may be health risks from mycotoxins, a causal association of illness with respect to mycotoxins remains weak and unproven. In particular, while many molds contain mycotoxins, studies have failed to establish routes of exposure.[1,5,6]

Mold has also been blamed for other health effects such as upper and lower respiratory illnesses, memory loss, and lethargy; however, there have been no studies confirming this. Microbial Volatile Organic Compounds (MVOC), which are the metabolites of fungi that cause the odors associated with mold growth, have been suspected as causing some of the health effects listed above. Once again, however, no association has been shown between the presence of MVOC and health effects, primarily because the MVOCs are produced in such minute levels.[6] According to the Centers for Disease Control and Prevention (CDC): "We do not know whether molds cause other adverse health effects, such as pulmonary hemorrhage, memory loss, or lethargy. We also do not know if the occurrence of mold-related illnesses is increasing."[9]

Scope of Environmental Health Officer Responsibilities

When necessary, DEHS will utilize a team approach responding to mold complaints. The EHO will be the technical leader of a team comprised of numerous individuals who either have a stake in the outcome, or have technical experience that might contribute to a solution. Examples of potential team members are healthcare providers; mold specialists; industrial hygienists; TDHE directors; community health nurses; and building inspectors. The role and involvement of the EHO will be limited to the following activities that are supported by current standards of best practices and the IHS Indoor Air Quality (IAQ) guidance document.

- Advocate for early preventive measures such as best practices for siting, design, and construction of homes and facilities.
- Provide educational materials and presentations to increase the general public's understanding and knowledge on mold and its potential health effects.
- Perform an initial assessment.
- Provide guidance and technical assistance to tribes and individuals on preventing the growth of mold and remediation.
- Consult with other healthcare providers, professionals, and authorities to alleviate potential health risks and effects.

Advocacy

EHOs should advocate local action requiring pre-construction mold prevention efforts. These efforts would include such considerations as proper site selection, design and

construction of buildings, and preventive maintenance in HUD-owned and publicly owned buildings.

Partnerships – Partnerships should be developed that include all stakeholders regarding mold issues. Some of the partners involved should include HUD; Tribes, Designated Tribal housing entities (TDHE); IHS Sanitation and Facility Construction (internal and external divisions); and other tribal, medical, or professional organizations.

Risk Communication

EHOs should develop or have access to educational programs based on known facts regarding health risks of mold. They should also learn the basic principles of risk communication in order to effectively address issues where the perception of risk differs significantly from the actual risk. Following is a list of resources that can aid in educational efforts:

- New York City Department of Health & Mental Hygiene Bureau of Environmental & Occupational Disease Epidemiology, "Guidelines on Assessment and Remediation of Fungi in Indoor Environments"[10]
- U.S. Environment Protection Agency (EPA) "A Brief Guide to Mold, Moisture, and Your Home"
- Office of Native American Programs (ONAP)/Housing and Urban Development (HUD) "Mold Prevention and Detection: A Guide for Housing Authorities in Indian Country"
- American Conference of Governmental Industrial Hygienists (ACGIH) "Building Air Quality"
- American Industrial Hygiene Association (AIHA) "The Facts About Mold"

Initial assessment

The assessment described here is meant to primarily apply to homes rather than facilities because a facility investigation may use various methods and techniques that are not appropriate for homes. The home assessment should be limited to a thorough visual identification of signs of mold and excessive moisture through non-destructive means.[10] The EHO should not collect samples or perform any activity that is destructive to the structure. A written report of assessment results should be sent to the appropriate parties.

Guidance

EHOs should consult the IAQ guidance document prepared by DEHS that provides details for investigating mold concerns and complaints. It also includes information on guidance and technical assistance to tribes regarding IAQ, mold, and mold remediation.

Testing – Sampling should rarely, if ever, be performed. If mold growth is identified, the moisture source must be eliminated and the mold growth abated, regardless of the species involved. If a thorough initial assessment fails to

identify the problem and there is still reason to suspect mold growth, then sampling by a qualified professional familiar with current guidelines, using a laboratory accredited through the Environmental Microbiology Laboratory Accreditation Program (EMLAP), may be warranted.

However, all testing methods for mold have limitations that can confound the interpretation of results. Depending on a number of factors, these limitations can over- or under-estimate spore concentrations. Moreover, given the lack of established health risks, there is little benefit to identifying the species of mold.

Remediation – The EHO should be knowledgeable of remediation methods for relatively minor infestations (<10 ft^2 of mold growth) in order to instruct individuals on proper remediation techniques.[10] For mold infestations greater than 10 ft^2, the EHO should provide guidance on identifying a reputable mold assessment and remediation contractor. In all cases, excessive moisture is the cause of mold growth and should be located and corrected or mold growth will recur.[10]

Summary

The IHS has a professional obligation to respond to concerns about mold; however, current scientifically valid literature does not substantiate an increased priority on mold issues. This paper clarifies the mold issue and defines the problem in terms of actual health risks rather than perceived risks. Providing a written statement defining the scope of responsibilities regarding mold issues sets limits on time and resources spent on these activities so that they are proportionate to the level of health risk. This will benefit American Indians and Alaska Natives by reserving resources for environmental health issues whose health risks have been confirmed by statistically significant data. This paper supports a continued yet limited EHO response to residential mold issues, which concentrates on prevention, remediation, and education rather than environmental sampling and health assessments.

The role of the EHO will be to serve as a member of a team made up of healthcare providers and other professionals with expertise in various disciplines. The scope of EHO activities regarding mold issues is:

- Advocate for early preventive measures such as best practices for siting, design, and construction of homes and facilities.
- Provide educational materials and presentations to increase the general public's understanding and knowledge on mold and its potential health effects.
- Perform an initial assessment.
- Provide guidance and technical assistance to tribes and individuals on preventing the growth of mold and remediation.
- Consult with other healthcare providers, professionals, and authorities to alleviate potential health risks and effects.

Mold, the common member of the fungi, is found nearly everywhere, indoors and outdoors. The current body of scientific knowledge regarding health effects of mold suggests that the presence of mold in a building constitutes a minimal health risk to the general population.[1,5,6] The most common health effect of indoor mold is immediate hypersensitivity, usually resulting in hay fever-like symptoms. The most important step to take to eliminate mold is to eliminate excessive moisture.[1,2,3,4]

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APPENDIX D: LIMITATIONS OF MOLD SAMPLING

The Measurement Problem Regarding Mold

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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, *Stachbotrys* 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. In 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) * (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

APPENDIX E: AGENCIES AND RESOURCES ADDRESSING MOLD AND MOISTURE PROBLEMS

Both government and non-government agencies provide information and resources towards mitigating and preventing mold and moisture problems. The resources also provide research results on the potential health effects of mold. In addition to providing descriptions of federal programs and initiatives, these resources provide general information on how to make homes mold-free and ensure superior indoor air quality.

Governmental Agencies and Resources Addressing Mold

1. U.S. Department of Agriculture (DOA)

Cooperative State Research, Education and Extension Services (CSREES)

CSREES' Housing and Environment program focuses on the Healthy Indoor Air for America's Homes Program, a national consumer educational program addressing specific problems, such as moisture and biologicals (molds, mildew), radon, asbestos, lead, etc. CSREES and HUD's Office of Healthy Homes collaborated to develop and distribute a self-help booklet for parents and caregivers entitled "Help Yourself to a Healthy Home." The booklet, based on the University of Wisconsin- Extension Home-A-Syst program, has been used in extension programs across the country.

Forest Products Lab

The Forest Products Laboratory (FPL) serves the public as the nation's leading wood research institute. Scientists and support staff conduct research on expanded and diverse aspects of wood use. Research concentrates on pulp and paper products, housing and structural uses of wood, wood preservation, wood and fungi identification, and finishing and restoration of wood products. FPL coordinates and collaborates with HUD's Office of Healthy Homes on research regarding the source of moisture and mold problems and the development of best practices to be shared with major industry partners.

Rural Development Programs

The Rural Development Programs provide funds for mold and mildew related repairs under the following programs:

a. Single Family Housing Repair Loans and Grants: Section 504

Low-interest home improvement loans and grants for very low-income people living in rural areas. Eligible activities for the use of funds include: grants funds can only be used on repairs and improvements to remove health and/or safety hazards while loan funds can be used to modernize or improve homes regardless of the removal of health or safety hazards.

b. Single Family Housing Home Improvement Loans: Section 502 Direct and Loan Guarantee

Loans intended for low to moderate-income people in rural areas to increase homeownership and to assist lower income homeowners in making necessary home improvements and repairs.

c. Housing Preservation Grant Program

This grant program is available to non-profit organizations, housing authorities and AIAN tribes to renovate deteriorating homes and rental properties (including repairs for mold/moisture problems). Funds can also be used for training and technical assistance. Program operates as a revolving loan fund: grants with matching fund.

USDA Resources

- "Help Yourself to a Healthy Home: Protect Your Children's Health" CSREES
  http://www.pueblo.gsa.gov/cic_text/children/healthyhome/intro.htm

- Forest Products Lab Website
  http://www.fpl.fs.fed.us/mold_qna.htm

2. U.S. Department of Commerce

National Institute for Standards and Technology

NIST conducts research in a wide variety of physical and engineering sciences that advances the nation's technology infrastructure and is needed by U.S. industry to continually improve products and services.

a. Building and Fire Research Laboratory

BFRL is a national laboratory and part of the NIST network, is dedicated to enhancing the competitiveness of U.S. industry and public safety through performance prediction and measurement technologies and technical advances that improve the life cycle quality of constructed facilities. It conducts studies including investigating the impact of moisture on the durability of buildings. Its Indoor Air Quality and Ventilation Group develops computer simulation programs and measurement procedures to better understand air and contaminant transport phenomena in buildings. This research provides valuable methods to evaluate ventilation characteristics and indoor pollutant concentrations in buildings.

3. U.S. Department of Energy

Oak Ridge National Laboratory (ORNL)

ORNL launched a major new research initiative to assess hydrothermal performance. This new initiative aims at setting the future direction for the design of building envelope systems and sub systems in the United States. The focus will be on energy efficiency, moisture-performance and system and sub-system durability. Its activities involving moisture management aims to develop a method that characterizes the dryability of wall envelope systems as it relates to moisture control. The analysis of moisture management performance will include systematic investigation of the properties (e.g., moisture storage capacity, liquid and vapor permeance) and of all key elements (e.g., cladding, air barrier, vapor barrier, second line of defense) of wall systems. The purpose is to establish objective criteria for materials and systems that will ensure acceptable long-term performance in a given climate. Finally, an experimental prototype will be developed and tested to determine the influence that the repetitive wetting and drying cycles of construction systems have on durability.

4. U.S. Department of Health and Human Services (DHHS)

Indian Health Service

Indian Health Service (IHS) has a variety of programs to educate tribes about mold through workshops, technical assistance and consultation. IHS works to raise tribal awareness regarding high moisture areas before tribes begin developing a site to prevent mold and moisture problems. Many homes in Indian Country are constructed on high water tables and flood plains. The reason for this is a shortage of buildable land on reservations. High water tables present a problem when homes are built with basements instead being lifted a few feet off the ground. IHS has witnessed a history of moisture problems in Indian Country due to basements in high water table areas and poor construction. Ever since tribes have taken over the decision-making process in construction there have not been any minimum standards established for construction. Poor site location and lack of good drainage systems are major sources of moisture in these homes.

IHS makes educational presentations to tribes about mold and moisture issues and has addressed construction standards in relation to these issues. IHS has evaluated homes when invited by Tribes and is encouraging better engineering practices for the construction of homes. IHS has made recommendations for rain management system, site selection, architectural design, and maintenance. IHS has asked tribes to share their building plans with them for review. Though some tribes have agreed to discuss building plans with IHS staff prior to construction, most have not been very receptive of the idea.

IHS does not have any set-aside funds specifically for mold mitigation, but rather funds are available to provide Environmental Health technical assistance and

consultation in regards to mold issues. Environmental Health staff are often invited to evaluate homes, tribal buildings, day care centers, etc., where mold exposure is suspected as causing health issues.

IHS has adopted guidelines on mold and moisture mitigation in Indian Country. IHS has published a position paper discussing health affects of mold based on current science.

Centers for Disease Control and Prevention (CDC)

CDC currently conducts numerous projects primarily related to the effect of mold on health.

a. National Center for Environmental Health (NCEH)

   This center conducts research in the laboratory and in the field to investigate the effects of the environment on health. Its programs track and evaluate environment-related health problems through surveillance systems.

b. Turtle Mountain Reservation

   In July 2001, following flooding in North Dakota, CDC investigated Turtle Mountain Reservation residents' concerns that mold contaminating their homes might be contributing to an increase in illness among tribal members. CDC assessed both the physical and environmental condition of the homes to identify any environmental hazards, including the presence of mold, and collected information on health conditions of the individuals living in the homes. CDC worked together with Indian Health Service and the Federal Emergency Management Agency (FEMA) on this project, as well as, HUD to identify procedures that might be implemented to assess conditions of HUD homes that would help to prevent mold.

c. Institute of Medicine

   The Institute of Medicine evaluates the relationship between damp or moldy indoor environments and the manifestation of adverse health effects. IOM began the study in January 2002 and is expected to complete it in the late summer or early fall of 2003.

d. Agenda for research, service, and education related to mold

   In response to concerns about mold and the gaps in scientific knowledge, CDC is developing an agenda for research, service, and education related to mold. The results of this effort will ultimately enable CDC to 1) make recommendations for reducing mold contamination; (2) identify environmental conditions that contribute to the occurrence of the disease

following mold exposure; and (3) assist state and local health departments in improving their capacity to investigate mold exposures.

DHHS Resources:

- Dr. Stephen Redd's testimony before the House Financial Services Housing and Community Opportunity and Oversight and Investigations Subcommittees Centers for Disease Control and Prevention (CDC)
  http://www.cdc.gov/washington/testimony/eh071802.htm

- NCEH Website
  Centers for Disease Control and Prevention
  http://www.cdc.gov/nceh/airpollution/mold/

5. U.S. Department of Housing and Urban Development

Office of Healthy Homes and Lead Hazard Control

This program office focuses on research, public education, and demonstrating effective assessment and intervention methods in order to protect children and their families from health and safety hazards (including mold and moisture) in the home. As a grants-based program, it awards grants on a competitive basis to public agencies and community organizations to conduct mold and moisture control projects, technical studies, research projects, and education projects.

Through its grants program and partnerships, Healthy Homes supports research on mold and moisture issues. Healthy Homes then utilizes the research to educate the general public about the health and safety hazards of moisture and mold in the home, and provide technical assistance to various government entities, community-based organizations, and private groups.

a. Guidebook

Healthy Homes and the U.S. Department of Agriculture (USDA) Extension Service have financed the publication of a guidebook created by the University of Wisconsin entitled, "Help Yourself to a Healthy Home; Protect Your Children's Health" (also available in Spanish).

b. Healthy Indoor Air for America's Homes Program

This is a national consumer educational program addressing specific problems, such as moisture and biological (molds, mildew) agents, radon, asbestos, lead, etc. The goal of this collaborative interagency effort is to provide basic knowledge and understanding of residential indoor air quality issues; to educate the public about sources, health risks, and control measures

related to common residential indoor air problems; and to help consumers reduce their health risks from these problems.

Office of Native American Programs

ONAP has been very proactive in addressing the problem of mold and moisture in housing in Indian areas. It is engaged in some of the most advanced and comprehensive data-collection on the root causes and remediation of moisture and mold issues. ONAP's major programs and products include:

a. Native American Housing Assistance and Self-Determination Act of 1996 (NAHASDA) makes grants on behalf of Indian tribes to carry out affordable housing activities. These funds can be used to aid families and individuals seeking affordable homes in safe, healthy environments.

b. Indian Community Development Block Grant Program (ICDBG) provides competitive funding for the development of viable Indian and Alaska Native communities, including the creation of decent housing, suitable living environments, and economic opportunities. The program also provides funding of identified imminent threats.

c. Mold and Mildew Technical Assistance Program involves the conduct of site visits and technical assistance on mold and moisture mitigation and prevention techniques to tribes that have self-identified mold and moisture problems. Training and education activities are conducted with tribal residents, both tenants and homeowners, as well as tribal housing staff through a regional trainings, a public education video, and a website.

d. Mold Prevention and Detection was recently updated and has been available on the Internet since March 2003. The previous guidebook was published on September 28, 2001 and has been available both in print and on the Internet. A video that accompanies the updated guidebook was funded in part by the Office of Healthy Homes.

Office of Policy Development and Research (PD&R)

a. Partnership for Advancing Technology in Housing (PATH)

PATH's mission is to "speed the development and use of new technologies, products and systems to improve the quality, energy efficiency, environmental performance, durability and affordability of the nation's housing."

- A durability study recently funded by PD&R through PATH was conducted by the National Association of Homebuilders (NAHB) Research Center that produced a manual entitled "Durability By Design: A Guide for Residential Builders and Designers" (May 2002). The purpose

of the manual is to "raise the awareness of and understanding of building durability as a design consideration." The manual investigates how various factors such as moisture affect durability and suggests recommended construction practices.

HUD Resources

- "Healthy Homes Initiative: A Preliminary Plan"
  Office of Healthy Homes and Lead Hazard Control
  http://www.toxicmold.org/documents/0243.pdf

- Healthy Public Housing, Harvard University
  Office of Healthy Homes and Lead Hazard Control
  http://www.hsph.harvard.edu/hphi/

- "Healthy Homes Issues: Mold"
  U.S. Department of Housing and Urban Development
  http://chppm-www.apgea.army.mil/mold/Mold_v2_12-01.pdf

- "Durability by Design: A Guide for Residential Builders and Designers"
  Office of Policy Development and Research (PD&R)
  http://www.huduser.org/publications/destech/durdesign.html

6. U.S. Department of Homeland Security

Federal Emergency Management Agency (FEMA)

FEMA has allocated some resources to mapping of flood plains in order to improve site selection for construction of new homes and prevent homes from being built in areas susceptible to floods. FEMA has committed $300 million to States for new mapping of flood plains, as flood plains have changed significantly over the years and many homes have unwittingly been constructed in flood plain areas. Most of this money will go to cities with high population densities, and not to tribes since they tend to be more sparsely populated. However, FEMA is working to obtain some set-aside funds for tribes for mapping purposes so they will be able to develop flood mitigation plans which are necessary to receive FEMA funds and participate in the flood insurance program.

FEMA is collaborating with HUD to share information about flood history and location of flood plains where HUD homes have been built (particularly tribal/TDHE housing). For example, FEMA has produced flood maps and identified HUD homes that are located in actual or potential floodplains areas as well as identified which tribes are located in high water table areas. The two agencies are planning to attend each other's regional conferences to discuss issues of site selection and information sharing.

7. U.S. Environmental Protection Agency

EPA's focus is on prevention and clean up of mold. EPA provides information through its website and guidebooks on moisture and mold and guidance on mold removal. Some research on mold types and their effects is being conducted through EPA's Office of Research and Development. EPA is also in the process of developing comprehensive guidance on mold assessment, and remediation in residences. The following are some of their products addressing mold and moisture problems in physical structures:

a. Guidebooks and Toolkits

- "A Brief Guide to Mold, Moisture, and Your Home"
- "Mold Remediation in Schools and Commercial Buildings"
- Indoor Air Quality Tools for Schools Kit

b. Tribal Capacity Building on Indoor Air Quality Investigative Techniques Pilot Program

This free hands-on pilot course was developed by the University of Minnesota and incorporates EPA's guidance on mold prevention and remediation as well as knowledge from professionals in the field. This course is intended to build the capacity of tribes to handle indoor air quality complaints by equipping TDHE and environmental staff with investigative techniques to recognize moisture and mold problems, find its source (building science), identify remediation solutions, and prevent future moisture issues.

c. Office of Pesticide Programs (OPP)

OPP is developing an approach to products used to eradicate mold, including potentially changing the labeling requirements to explain the need for a more comprehensive approach.

EPA Resources

- "A Brief Guide to Mold, Moisture, Mildew and Your Home" http://www.epa.gov/iaq/molds/moldguide.html
- "Mold Remediation in Schools and Commercial Buildings" http://www.epa.gov/iaq/molds/mold_remediation.html
- "Biological Pollutants in Your Home" http://www.epa.gov/iaq/pubs/bio_1.html

- "Mold Resources"
  http://www.epa.gov/iaq/molds/moldresources.html

- "Tools for Schools"
  http://www.epa.gov/iaq/schools/tools4s2.html

Non-Federal Governmental Resources for Mold

A number of non-federal government agencies also have programs, conduct research and provide information for mold and moisture issues. These agencies have a variety of backgrounds; some are state and local government entities, building research groups, universities and non-profit organizations. Some agencies provide research on the health effects of mold and others work to mitigate the effects of mold on physical structures.

- "Mold in Residential Buildings"
  National Association of Homebuilers, Toolbase.org
  http://www.toolbase.org/tertiaryT.asp?CategoryID=1554&DocumentID=2944&TrackID

- "Indoor Air quality Tools Education Prevention and Investigation,"
  University of California Industrial Hygiene Work Group
  http://ehs.ucsc.edu/ih/IAQC/IAQC-intro.html

- University of Minnesota Environmental Health and Safety Program- Indoor Air Quality
  http://www.dehs.umn.edu/iaq/

- "Guidelines on Assessment and Remediation of Fungi in Indoor Environments,"
  New York City Department of Health & Mental Hygiene Bureau of Environmental & Occupational Disease Epidemiology
  http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html

- Healthy Home Institute
  http://www.hhinst.com/

- Health House
  http://www.healthhouse.org/about/history.asp

- Energy and Environmental Building Association
  http://www.eeba.org/

- National Safety Council Indoor Air Program
  http://www.nsc.org/ehc/indoor/iaq.htm

- Engineered Wood Association
  http://www.buildabetterhome.com/

- American Industrial Hygiene Association
  www.aiha.org

- American Lung Association,
  www.lungusa.org/

- *Home Energy* (magazine)
  www.homenergy.org

- National Multi Housing Council (NMHC) and the National Apartment Association (NAA), Operations and Maintenance (O&M) Plan for Mold and Moisture Control www.nmhc.org/ and www.naahq.org/moldReq.htm

- Health Canada, Health Protection Branch, Laboratory Centre for Disease Control, Office of Biosafety
  http://www.hc-sc.gc.ca/pphb-dgspsp/msds-ftss/index.html