# RESEARCH REPORT

## A Study of Recurring Mold Problems on the Roseau River Reserve, Manitoba

Canada

CMHC SCHL
HOME TO CANADIANS

# CMHC—HOME TO CANADIANS

Canada Mortgage and Housing Corporation (CMHC) has been Canada's national housing agency for more than 60 years.

Together with other housing stakeholders, we help ensure that Canada maintains one of the best housing systems in the world. We are committed to helping Canadians access a wide choice of quality, affordable homes, while making vibrant, healthy communities and cities a reality across the country.

For more information, visit our website at **www.cmhc.ca**

You can also reach us by phone at 1-800-668-2642 or by fax at 1-800-245-9274.

Outside Canada call 613-748-2003 or fax to 613-748-2016.

Canada Mortgage and Housing Corporation supports the Government of Canada policy on access to information for people with disabilities. If you wish to obtain this publication in alternative formats, call 1-800-668-2642.

CANADA MORTGAGE AND HOUSING CORPORATION

# A STUDY OF RECURRING MOLD PROBLEMS ON THE ROSEAU RIVER RESERVE, MANITOBA

FINAL DRAFT

CMHC SCHL
Helping to house Canadians

# A STUDY OF RECURRING MOLD PROBLEMS ON THE ROSEAU RIVER RESERVE, MANITOBA

by
Bill Boles
Boles Construction

Virginia Salares, Project Manager

One of the ways CMHC contributes to the improvement of housing and living conditions in Canada is by communicating the results of its research. Contact CMHC for a list of available information products on a variety of social, economic, environmental and technical housing-related topics.

Phone 1-800-668-2642 or visit us on the World Wide Web: www.cmhc-schl.gc.ca

Cette publication est aussi disponsible en français sous le titre [ TITLE, PF#].

This project was funded by Canada Mortgage and Housing Corporation (CMHC) but the views expressed are the personal views of the author(s) and CMHC accepts no responsibility for them.

copyright
ISBN
catalogue data

CANADA wordmark

# FOREWORD

May 13, 1998

The spring of 1997 was marked by swelling rivers which caused devastating floods in Manitoba. Families were forced to leave their homes. Although most families have gone back to their homes, it will take years before the effects of the flood are fully assessed.

The Roseau River Reserve was built on a flood plain in an area bounded by the Roseau River and the Red River. A dike protects most of the houses on the reserve, but there are houses outside of the protected area. In the past year, rehabilitation of homes affected by the flood has been ongoing through combined efforts of Emergency Measures Organization, Indian and Northern Affairs, Health Canada, CMHC and the Band.

Test results from Health Canada in early 1998, indicated contamination of some houses on the reserve with the mold *Stachybotrys chartarum*. Consequently, many of these houses have undergone repeated remediation.

Because indoor air quality (IAQ) is linked to the health of the occupants, there is a strong interest to determine the air quality of houses in general, and of houses in flooded areas in particular. An investigative protocol for IAQ purposes has been developed by CMHC but is not yet widely implemented. The situation at the Roseau River Reserve offered an opportunity to explore the indoor air quality issue using this protocol. Are there IAQ problems on the reserve and if so, are these limited to homes that were flooded? Has the remediation been successful? The results would be applicable for other communities where similar rehabilitation efforts are underway.

Virginia Salares
Senior Researcher
Research Division

Tel. (613) 748-2032
Fax (613) 748-2402

# PURPOSE

The purpose of this research report was to do the following:

- review the remediation and testing that has been done at the Roseau River Reserve, in consultation with a First Nations representative;
- identify eight houses on the reserve to be investigated from three categories: those that were flooded and previously cleaned and remediated, those that were flooded but not yet remediated and houses that were not flooded but appear to have mold and mildew problems;
- investigate the houses for indoor air quality problems and document the problems with photographs;
- prepare recommendations for remediation of the houses; and
- summarize the results, including recommendations for action to be taken for other houses in the community.

# ACKNOWLEDGMENTS

The author wishes to thank the house occupants and individuals who offered their assistance and cooperation during the on-site phase of the study in Manitoba.

The author would also like to thank Virginia Salares for her advice and support throughout the project.

# EXECUTIVE SUMMARY

The Roseau River Anishinabe First Nation Reserve in southern Manitoba was evacuated from April 23, 1997 to May 22, 1997 due to flooding of the Red River. Although most of the 204 homes are surrounded by a dike, some flooding did occur. That flooding was almost exclusively limited to basement seepage below grade, along with some sewage back-up. Although the basements were cleaned and, in some cases, renovated, recurring mold continues to be a problem. Of more than 114 homes that were flood damaged, at least 34 have been identified as contaminated with *Stachybotrys chartarum* (also known as *Stachybotrys atra*), a dangerous mold. At least 53 other homes have been identified as contaminated with various other molds.

The purpose of this report was to investigate the recurring mold problems at the Roseau River Reserve through a sample study of eight homes both inside and outside the dike, using the Canada Mortgage and Housing Corporation *Indoor Air Quality Investigative Protocol.* Eight houses had suffered basement seepage or flooding. Four of those had previously been identified as contaminated with *Stachybotrys chartarum* while two others had been previously identified as contaminated with other molds.

Recommendations for each of the eight homes, for other homes in the community, for home occupants and for new construction are included in this report.

The house investigations performed for this report cannot confirm that mold remediation previously undertaken and currently being implemented is effective. There was evidence of mold in all eight houses. New drywall, paint and tile floors have made the living areas of some of the investigated houses look clean but the extent of the visible mold in the one house where the walls were uncovered at the time of inspection leads to the suspicion of similar mold covered up in other renovated houses.

Except for some improvements made to sump pits and floor drains, most of the recent renovations are best described as cosmetic and do nothing to resolve the underlying causes of recurring mold problems. Waterproofing, drainage and ventilation have been ignored.

Poor site drainage resulting in seepage into basements is the largest single contributing factor to the mold problems. Unless water entry is stopped, mold problems will continue.

The original building construction techniques have made the buildings, particularly the foundations, more susceptible to moisture and mold problems. Deep basements insulated and finished on the interior, insufficient drainage provisions, poor detailing of the above grade envelopes and inadequate mechanical ventilation, along with inadequate maintenance, have all exacerbated the problems.

Other pollutants, particularly environmental tobacco smoke, are contributing to poor indoor air quality.

More effective mold clean-up will only provide a short term solution. Remediation of the underlying causes of the mold growth is required.

Unless there is a dramatic shift in focus, the current cycle of mold contamination, remediation and renovation should be expected to continue repeatedly, with no end in sight. Current financial costs and family hardship should be considered to be ongoing. These costs can be considered an

opportunity for change. One long-term, effective solution rather than the current, repeated, ineffective solutions may provide savings of both money and family hardship.

A shift in focus is offered in the recommendations contained in this report. That shift includes insulation of existing basements on the exterior; provision of new shallow crawlspace foundations for some houses; installation of better mechanical ventilation; and development of a model construction and inspection standard for new construction. It is recommended that any new homes be energy efficient slab-on-grade bungalows; suitable for the high occupancy rate, poor drainage and cold climate of this community.

# ÉTUDE DES CAS RÉPÉTITIFS DE MOISISSURE DANS LA RÉSERVE DE LA RIVIÈRE ROSEAU AU MANITOBA


RÉSUMÉ

---

La réserve de la Première nation anishinabe de la rivière Roseau, située dans le sud du Manitoba, a été évacuée du 23 avril au 22 mai 1997 en raison de l'inondation de la rivière Rouge. Malgré la digue entourant la plupart des 204 maisons, il y a bel et bien eu des cas d'inondation qui se limitaient presque exclusivement à des infiltrations d'eau dans les sous-sols et au refoulement d'égouts. Les sous-sols ont été nettoyés et, dans certains cas, rénovés, mais la manifestation répétitive de moisissure pose toujours problème. Parmi les 114 maisons inondées, on a établi que 34 ont été contaminées par la moisissure nocive Stachybotrys chartarum (aussi connue sous le nom de Stachybotrys atra) et que 53 autres maisons l'ont été par différentes autres moisissures.

Le présent rapport a pour objet d'étudier, grâce à un échantillon de huit maisons situées aussi bien à l'intérieur qu'à l'extérieur de la digue, les manifestations répétitives de moisissure au sein de la réserve de la rivière Roseau, à l'aide du *Protocole d'investigation de la qualité de l'air intérieur* mis au point par la Société canadienne d'hypothèques et de logement. Le sous-sol de sept des huit maisons avait subi des infiltrations d'eau ou des inondations. On avait établi auparavant que quatre d'entre elles avaient été contaminées par la moisissure Stachybotrys chartarum et que deux autres l'avaient été par d'autres moisissures.

Le présent rapport livre des recommandations à l'égard de chacune des huit maisons, d'autres maisons de la collectivité, des occupants des maisons ainsi que des constructions neuves.

Les investigations effectuées dans les maisons pour les besoins du présent rapport ne peuvent pas attester l'efficacité des travaux d'élimination de la moisissure déjà exécutés ou actuellement en cours d'exécution. Les huit maisons recelaient toutes des traces de moisissure. Les nouveaux revêtements de plaques de plâtre, de peinture et de tuiles ont conféré aux aires habitables de certaines maisons étudiées une allure de propreté, mais l'étendue des moisissures visibles dans la maison où les murs ont été éventrés lors de l'inspection laisse présumer que les autres maisons rénovées dissimulent des moisissures semblables.

Exception faite de certaines améliorations apportées aux puisards et aux avaloirs de sol, la plupart des travaux de rénovation effectués récemment ont un caractère plutôt esthétique, ne s'attaquant d'aucune manière aux causes sous-jacentes de la manifestation répétitive des cas de moisissure. Aucune mesure de protection contre l'eau, de drainage et de ventilation n'a été adoptée.

Le drainage inapproprié des lieux, qui a mené aux infiltrations d'eau dans les sous-sols, constitue la plus importante cause de la manifestation de moisissures. À moins de stopper l'infiltration d'eau, les problèmes de moisissure se répéteront sans cesse.

Les techniques de construction originales ont prédisposé les bâtiments, leurs fondations en particulier, aux problèmes d'humidité et de moisissure. La construction de sous-sols hauts, isolés et finis sur leur face intérieure, des mesures de drainage insuffisantes, une piètre exécution des composantes de l'enveloppe au-dessus du niveau du sol et le manque de ventilation mécanique, en plus d'un entretien inadéquat, ont tôt fait d'empirer la situation.
D'autres polluants, en particulier la fumée de tabac, ont nui à la qualité de l'air intérieur.

Éliminer efficacement la moisissure ne fait que régler la situation à brève échéance. Il faut résolument s'attaquer aux causes sous-jacentes de la prolifération de la moisissure.

À moins d'un changement d'orientation spectaculaire, on peut s'attendre à ce que le cycle actuel de contamination, de mesures correctives et de rénovation se poursuive de façon répétitive, sans qu'on puisse en prévoir la fin. Les coûts financiers et les épreuves des familles doivent être considérés comme continuels. Ces coûts fournissent une occasion d'amorcer un changement. Une solution efficace à longue échéance pourrait épargner aux familles argent et épreuves.

Les recommandations formulées dans le présent rapport offrent un changement de cap. Elles préconisent l'isolation extérieure des sous-sols des bâtiments existants, l'aménagement de certaines maisons sur des fondations superficielles avec vide sanitaire, l'installation de systèmes de ventilation de qualité supérieure, l'élaboration d'une norme modèle de construction et d'inspection à l'égard de la construction neuve. Il est recommandé que toute maison neuve soit un bungalow écononergétique érigé sur une dalle sur terre-plein, se prête à un taux d'occupation élevé et aux conditions climatiques rigoureuses que connaît cette collectivité.


National Office
700 Montreal Road
Ottawa ON K1A 0P7
Telephone: (613) 748-2000

Bureau national
700 chemin de Montréal
Ottawa ON K1A 0P7
Téléphone : (613) 748-2000

Puisqu'on prévoit une demande restreinte pour ce document de recherche, seul le résumé a été traduit.

La SCHL fera traduire le document si la demande le justifie.

Pour nous aider à déterminer si la demande justifie que ce rapport soit traduit en français, veuillez remplir la partie ci-dessous et la retourner à l'adresse suivante :

Centre canadien de documentation sur l'habitation
Société canadienne d'hypothèques et de logement
700, chemin Montréal, bureau C1-200
Ottawa (Ontario)
K1A 0P7

Titre du rapport: _____

_____

Je préférerais que ce rapport soit disponible en français.

NOM _____

ADRESSE _____
rue App.

_____
ville province Code postal

No de téléphone ( ) _____

# TABLE OF CONTENTS

# LIST OF FIGURES

# INTRODUCTION

The Roseau River Anishinabe First Nation Reserve in southern Manitoba is a community of approximately one thousand people inhabiting two hundred and four houses located near the junction of the Roseau and Red rivers.

The main part of the community consists of approximately one hundred and sixty homes located within a dike designed to protect them from spring river flooding. Most of these are connected to community water and sewer systems. Some others use cisterns to store water that is trucked from a central station and use holding tanks for sewage which is trucked to a community sewage lagoon.

Nine houses are located near the main community but are outside the dike. All of them use cisterns for water and holding tanks for sewage, except for one which has a septic field.

Thirty-two houses are located on a separate parcel of land about twenty kilometers from the main reserve. Known as the Roseau River Rapids, there are sixteen houses in the North Rapids and sixteen houses in the South Rapids.

During the Red River flood of 1997, this community was evacuated from April 23 to May 22. There was no above ground flooding within the protective dike but there were numerous instances of water seepage and sewage back-up into basements below grade. For safety reasons, electricity was shut off to the houses during the flood. Sump pumps were therefore not able to combat the seepage. Outside the dike, the flooding was worse but was still almost exclusively below the main floor level. However, affected houses both inside and outside the dike were closed up with no heat, standing water in the basements and air saturated with water vapour for much of the period of the evacuation. At least one hundred and fourteen homes have been identified by the Manitoba Emergency Management Organization (MEMO) as having suffered flood damage, the vast majority of which is basement related.

As of February 26, 1998, a Health and Welfare Canada list identified fifty-three homes as being contaminated with various unspecified molds. Another thirty-four homes were identified as being contaminated with *Stachybotrys chartarum*, a type of mold that has been labelled as "dangerous" by the American Industrial Hygiene Association. Some of these homes had already been re-insulated and finished following the flood of 1997. A number of finished basements have had the recently installed drywall, insulation and framing stripped out and discarded again. Discovery of mold contamination is ongoing.

Some homes apparently flood annually. The flooding in 1997 was just worse than in other years.

Certain homes have been tested; found contaminated with *Stachybotrys chartarum*; cleaned; tested again and found to be contaminated again. A *Summary of Mold March 31, 1998*, prepared by the Roseau River Anishinabe First Nation reports that financial cost of evacuation and cleaning due to mold had exceeded $938,000.00. Discussion at a "Mold Meeting", April 15, 1998, which included representation from the Roseau River Anishinabe First Nation, Manitoba Emergency Management Organization (MEMO), Indian and Northern Affairs Canada (INAC) and Canada Mortgage and Housing Corporation (CMHC) reported structural repair costs due to flooding by that date to have exceeded $484,000.00. The social cost of uprooting families from their homes once for flooding and again, sometimes more than once, for mold contamination, is incalculable.

This report is an attempt to investigate the recurring mold problems at the Roseau River Reserve through a sample study of eight homes. The field study was conducted from

April 15, 1998 to April 18, 1998, using the CMHC Indoor Air Quality Investigative Protocol. Observations and recommendations for each house are followed by general recommendations for other houses in the community, recommendations for home occupants and recommendations for new construction. It is hoped that this report will contribute to understanding, and breaking, the repetitive cycle of mold contamination, remediation and renovation.

# HOUSE INVESTIGATIONS

*Note: Recommendations to improve indoor air quality are offered for each house. These recommendations are divided into measures that can be done easily at no or low cost, measures that are of medium cost and finally measures that are of higher cost. In each category the recommendations are listed in approximate order of importance. Some recommendations which serve similar purposes are found in two or three categories. They are offered as options. The differences between them are largely based on cost and effectiveness. For example, repairing a broken bathroom exhaust fan, upgrading to a more effective fan and installing a heat recovery ventilator which exhausts air from the bathroom all serve a similar purpose but the cost and effectiveness of each is different.*

## Investigation #1: House A-39

### Reported History

This house is within the dike and suffered basement flooding to a depth of two feet in May, 1997. A MEMO (Manitoba Emergency Management Organization) Site Inspection dated January 20, 1998 reports that no visible mold, efflorescence or moisture were noted. The occupant suggested that this house be investigated in order to provide a wider cross-section of investigation and because, although no flooding had occurred, the air quality seemed in need of improvement.

***Key Points:***

- Flooded 2 feet deep, May, 1997
- Shallow foundation (floor less than 1m (3 feet) below grade

Figure 1:
House A-39, Front

**Site Observations April 15, 1998**
Weather: Clear, sunny, +2C, approximately 80% relative humidity

Following the CMHC IAQ Problem House Survey protocol through an inspection of the exterior, basement, mechanical system, kitchen, bathrooms and other rooms, some of the observations noted were as follows:

*Exterior*
- the site: flat, poorly drained
- the house: wood frame split level with shallow poured concrete foundation
- poor grading adjacent to the foundation wall
- wood siding on the front is unfinished and discoloured
- pre-finished hardboard siding on 3 sides buckled in places; missing some corners, waterstained
- no eavestroughs
- fresh air intake to return air trunk of furnace partly clogged with dust on the bug screen
- exhaust duct hood on the roof
- single panes broken in 2 triple glazed windows

*Basement*
- basement walls framed, insulated and drywalled
- slight stale odour upon entry; slight basement musty smell
- sealed sump pit
- open floor drain with standing water
- poorly insulated fresh air intake to return air trunk
- wood-electric furnace: wood not used
- clogged fibreglass furnace filters
- long, winding, constricted dryer exhaust flex duct
- no air/vapour barrier at the main floor rim joist

*Main Floor*
- recirculating range hood, ineffective main bathroom exhaust, no ensuite bathroom fan
- forced air system: only a few returns, room doors not undercut
- older carpet in most main floor rooms
- visible mold in the caulking at the edge of every window and in the caulking at the rear of the main bathroom vanity
- measured relative humidity: basement 51%; kitchen 49%; bathroom 48%
- occupants smoke in the house

**Recommendations**

*Key Points:* Air quality improvement in this house requires: some mold clean-up; elimination of some indoor pollutants; better ventilation, air circulation and dehumidification; and better protection from water penetration.

*Low Cost Recommendations*

1. For the home occupant: follow the general guidelines for homeowners listed in this report and in relevant CMHC literature. In particular, ban smoking in the house.

2. Clean up the small areas of visible mold according to the CMHC booklet *Clean-up Procedures for Mold in Houses*. (See primary recommendation listed under General Recommendations.)

3. Remove as much carpet as possible. The carpets retain moisture and and stale odours while providing a haven for dust mites and mold. The area covered by carpet in the house is significant. Ideally, take it all out. Practically, start with areas of high occupancy, such as the bedrooms. Plywood subfloors with hard surface finish flooring are preferable to carpet. (See higher cost recommendation #2).

4. Clean dust from the bug screen on the fresh air intake to the return air trunk of the furnace. (See higher cost #1).

5. Operate the bathroom exhaust fan often, even though the flow rate is minimal.

6. Install a retrofit rubber backwater valve in the basement floor drain to minimize standing water in contact with house air. Disinfect the floor drain periodically with a bleach and water solution.

7. Replace the fibreglass furnace filters with electrostatic pleated filters. Maintain periodically.

8. Replace the dryer exhaust flex duct with sheet metal aluminum duct. Seal all joints with aluminum foil tape.

9. By hand, remove any debris that has been placed in air system ducts.

*Medium Cost Recommendations*

1. Replace the broken panes in the windows. Only the individual glass & sash units need to be replaced; do not replace the complete window frames. This is mainly a safety issue but will also provide warmer surfaces which will help reduce mold growth.

2. Duct the existing range hood through the wall to convert it from recirculating to outside exhaust. Alternatively, upgrade to a new range hood which exhausts to the exterior. Note that depressurization and resulting backdrafting of the wood furnace could be a concern. Depend on a reliable contractor certified by the Heating, Refrigerating and Air Conditioning Institute in residential mechanical ventilation.

3. Upgrade the exhaust fan in the main bathroom as noted above. Reduce any condensation problems by installing insulated sheet metal duct sloped to an outside termination in clear air under the soffit. Install a through the wall exhaust fan in the ensuite bathroom. Both of these bathroom fans would be rendered unnecessary with the installation of a balanced heat recovery ventilation system (see higher cost #1).

4. Repair any buckled siding, missing corners or missing drip caps to prevent water penetration. Check the roof for potential leaks.

5. Install eavestroughs, downspouts and extensions to direct rainwater away from the foundation.

6. Improve the grading around the foundation.

7. Purchase and use a portable dehumidifier to reduce basement humidity.

8. 'Tighten up' the building envelope with better sealing of the air/vapour barrier. In particular, there is no air/vapour barrier covering the insulation at the rim joist. Particularly with high humidity in the building, this can lead to mold and rot at the rim joist. There are several options for airsealing at the rim joist: sealed poly; pre-formed 'poly pans'; extruded polystyrene cut, fit and sealed or foamed in place and covered by gyproc for fire protection. None are easy to fit between floor trusses. This is labour intensive.

9. Undercut any room doors necessary to ensure good return air flow to the central returns. When air circulation balance is improved, run the furnace fan as continuously as possible. This may prove difficult with a one speed fan which will tend to create cool drafts in winter and be very energy inefficient. A two speed fan is recommended.

*Higher Cost Recommendations*

1. Install a balanced heat recovery ventilation system, the ideal choice to improve ventilation. Individual bathroom exhaust fans or fresh air intakes to the return air trunk are no longer necessary with this type of whole house system.

2. Replace the carpets with hard surface flooring. Although ceramic tile or prefinished hardwood are usually preferred, composition vinyl tiles are probably the most appropriate choice here.

## Investigation #2: House A-33

### Reported History

This house is a wood frame bungalow with full poured concrete foundation, built between 1975 and 1984. There are two adult occupants plus children. It is within the dike in an area prone to basement flooding. The basement was flooded due to seepage or sewer back-up in May of 1997. It is identified on a Health and Welfare Canada list dated February 26, 1998 as being contaminated with mold (unspecified). According to the undated remediation list provided by the band, the following remediation has been performed: strip out, power vac, power wash, clean ups, electrical, plumbing. Mold remediation apparently included application of an unspecified anti microbial agent. The basement remains uninsulated and unfinished.

The occupants report the following:

- the air is dry in winter
- water frequently condenses on window panes
- the house is damp and humid in summer
- ants are a problem
- both adult occupants smoke in the house
- one adult occupant has asthma and breathing problems and associates those problems with a persistent moldy odour most noticeable in the basement.

***Key Points:***

- Full basement subject to flooding (floor 1.5m (5 feet) below grade)
- Previous mold contamination and remediation
- Environmental tobacco smoke

Figure 2:
House A-33, Front, East

**Site Observations April 15, 1998**
Weather: Clear, sunny, +6C, approximately 46% RH

Some observations noted:

*Exterior*

- flat, poorly drained site
- poor grading against the foundation walls
- downspouts direct water against the foundation
- exterior stucco finish deteriorating in places
- two windows have broken panes
- dryer exhaust hood; no other air exhausts or intakes

*Basement*

- basement floor 5 feet below grade
- basement interior framing and insulation stripped out and presently unfinished
- single glazed basement windows
- new electric furnace and water heater
- sealed sump pit; sump pump runs frequently
- floor drain open; sewer smell
- efflorescence on basement walls particularly near snap-ties
- dirty fibreglass furnace filter
- dryer exhaust: flex duct
- evidence of dampness and mold at rim joist, lower corners and wall/floor junction

*Main Floor*

- evidence of mold on drywall at base of wall under dining room window
- condensation between panes of kitchen window
- recirculating range hood
- slight mold in caulking at edge of windows
- measured relative humidity: basement 57%; kitchen 58%; bathroom 55%

**Recommendations**

*Key Points:* This house exhibits many signs of both ineffective protection from water penetration and almost non-existent ventilation.

Air quality improvement in this house requires: elimination of environmental tobacco smoke; some additional mold clean-up; protection from water leakage or back-up; improved ventilation; and dehumidification.

***Primary Recommendation***

Any house previously identified as moldy, particularly if that mold is *Stachybotrys chartarum* must be thoroughly cleaned with bleach, according to the directions in the CMHC booklets *Clean-up Procedures for Mold in Houses* and *Toxic Mold Clean-up Procedures*. Visible patches of mold must be disinfected with undiluted household chlorine bleach. The whole house, both basement and main floor, must be washed with the prescribed bleach cleanser (one part bleach, four parts water and a couple of drops of non-ammonia dishwashing detergent).

Any non-washable furnishings or possessions from moldy basements (e.g. sofas, cushions or mattresses, etc.) must be discarded. Any furnishings or possessions from the main floor must be removed from the house during the house cleaning. Any washable furnishings or possessions,(for example: curtains, wooden or plastic furniture) must be washed with a bleach cleanser before being returned to the house. Moldy furnishings, if returned to a house that has been de-contaminated, would be a source of mold spores.

Non-washable furnishings or possessions must be evaluated on a case-by-case basis. Moisture and mold can penetrate soft or upholstered furnishings. Any attempt to disinfect mold on the surface of such items is likely to be ineffective, particularly if the furniture had been exposed over a long period of time to conditions favourable to mold. In houses identified as contaminated with *Stachybotrys chartarum*, furnishings subjected to very moist conditions for several weeks should be suspected of being sources of re-contamination and consequently the recommendation is to discard them.

Both occupants and workers must be protected during mold clean-up and severely contaminated areas must be isolated from the rest of the house.

Sampling for mold must be undertaken a few days after the mold clean-up, before the houses are re-occupied. Periodic sampling for mold is recommended.

***Low Cost Recommendations***

1. Follow the general guidelines for homeowners listed in this report and in relevant CMHC literature. In particular, ban smoking in the house.

2. Patch any foundation snap-tie holes, wall cracks or floor cracks from the inside.

3. Install a retrofit rubber backwater valve in the basement floor drain. Disinfect the floor drain periodically with a bleach and water solution.

4. Investigate the patch of deteriorated drywall at the base of the dining room wall under the window. Clean up any mold.

5. Patch the deteriorated stucco and caulk around windows and doors to prevent water leakage.

6. Extend the eavestrough downspouts away from the foundation wall.

7. Install insulated sheet metal duct from the bathroom ceiling exhaust fan to an exhaust hood terminating in clear air on the underside of the soffit. Slope the duct so condensation will drain to the hood. (See higher cost recommendation 2).

8. Replace the fibreglass furnace filter with a pleated electrostatic filter. Maintain periodically.

9. Undercut necessary room doors to provide return air delivery to the central returns. Run the furnace fan as continuously as possible to provide better air circulation.

*Medium Cost Recommendations*

1. Although it is beyond the scope of this investigation to determine the below grade drainage characteristics around and under the foundation, it is important that any ground water has a path to the sump pit. Ensure that there are drainage tiles leading there. If not, trench the concrete floor around the inside perimeter of the walls and install drainage tile leading to the sump pit. (See higher cost #1)

2. Install an upgraded bathroom exhaust fan or a central exhaust sysem with intakes in the kitchen and bathroom. (See higher cost recommendation #2)

3. Due to its poor location on an interior wall, changing the kitchen recirculating range hood to an outside exhausting hood remains a problem. However, the benefits of exhausting cooking odours and humidity outside should not be overlooked. Any kitchen renovation should include re-locating the range to an exterior wall and installing an exhausting range hood.

4. Insulate the foundation on the exterior from the top of the foundation wall to 2' below finished grade with extruded polystyrene complete with a protective foundation coating and drip cap. (See higher cost #1)

5. Raise and slope the grade adjacent to the foundation.

6. Install insulation and a sealed air/vapour barrier in the joist spaces along the inside face of the rim joist, from the underside of the floor sheathing to the top of the foundation wall. Alternatively, while insulating the foundation on the exterior, remove the exterior finish up to the top of the floor framing and insulate that area on the exterior in the same manner that the foundation is being insulated.

7. Dehumidify the basement as required (particularly in summer) with a portable dehumidifier.

8. Replace the single glazed basement windows with double glazed thermal units. Replace broken window panes in the living room and dining room, and the kitchen glazing unit that has a broken seal.

*Higher Cost Recommendations*

1. Excavate and waterproof the exterior of the foundation walls. Install full height free-draining exterior insulation. Install perimeter drainage connected to the sump pit or sewer drainage system. Install a waterproofing membrane over the present floor and pour a new concrete topping slab. (Note: this does not completely resolve the connection at the floor/wall interface.)

2. Install a balanced heat recovery ventilation system integrated with the existing forced air heating system. This type of system renders individual bathroom fans unnecessary. Install a two speed fan in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

## Investigation #3: House A-41

### Reported History

This house is a wood frame bungalow with a full poured concrete foundation, built between 1975 and 1984. There are six occupants. It is within the dike but the basement has flooded due to seepage or sewer back-up on more than one occasion. Basement renovations in 1997 included new framing, fibreglass insulation, drywall and windows. Main floor renovations included windows, drywall, paint and tile floors.

In March of 1998, the basement floor was flooded to a depth of nine inches. A temporary pump was used to drain the water. A complete strip out of the wet framing was deemed unnecessary. The lower half of the basement drywall and insulation was removed but the studs were left in place. The following remediation was performed: power vac, power wash, clean ups, electrical, plumbing. Mold remediation apparently included application of an unspecified anti microbial agent. This house was not identified as moldy on the Health and Welfare Canada list dated February 26, 1998. It has apparently not yet been re-tested for mold.

The occupants report the following:

- cold floors
- dry air in winter
- occasional condensation on windows
- items stored in the basement become damp
- odours linger after cooking
- ants are a problem
- some occupants smoke in the house

***Key Points:***

- Basement flooding 1997 (basement floor about 1.5 m (5 feet) below grade)
- Extensive renovations 1997
- Basement flooding March 1998
- Mold remediation 1998

Figure 3:
House A-41, Front

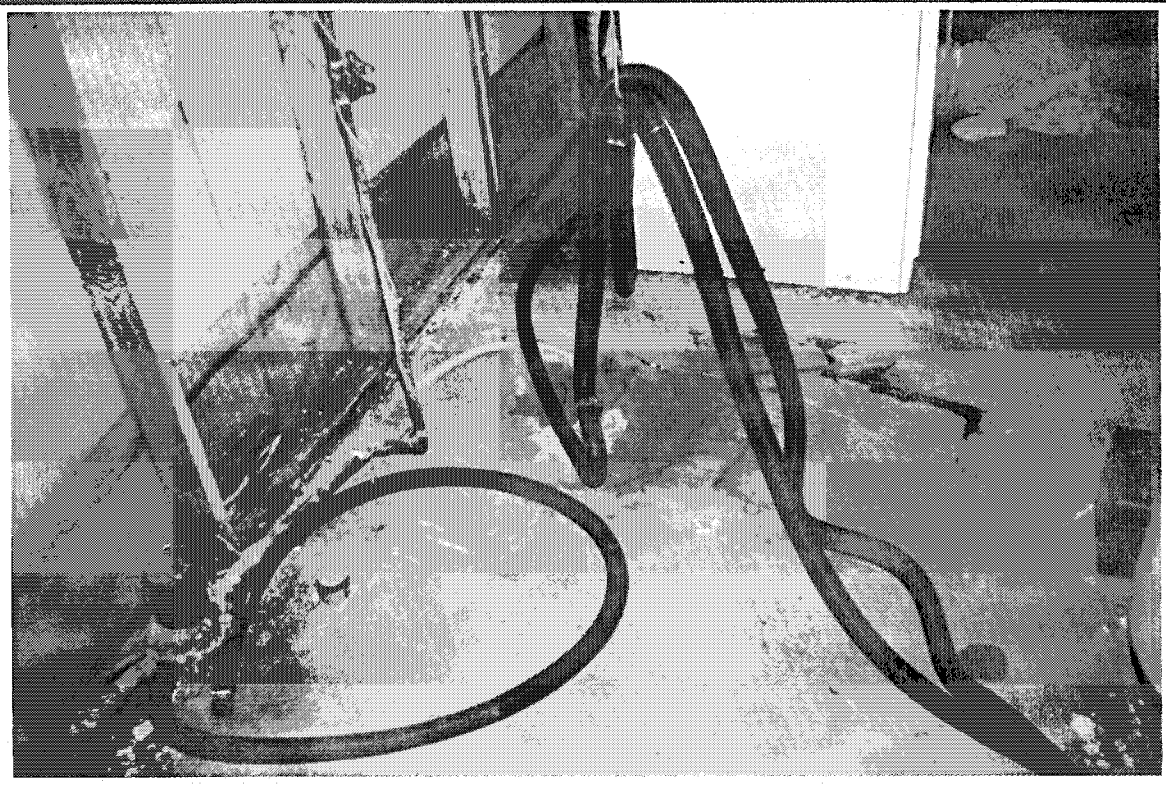
**Site Observations April 16, 1998**
Weather: sunny; +6C, approximately 45% RH

Some observations noted:
*Exterior*
- flat, poorly graded site
- poor grading against the foundation walls
- eavestrough downspouts direct water against the foundation
- the exterior stucco has deteriorated along the bottom edge
- two basement windows are broken
- no drip cap over side entrance door
- shingles have lifted or are missing from two places on the roof
- dryer exhaust hood; no other air exhausts or intakes

*Basement*
- basement floor about 5 feet below grade
- lower half of basement fibreglass insulation and drywall stripped out, presently unfinished
- lower part of exposed basement framing is wet and black . Moisture meter readings indicate: studs at midpoint 12%; bottom plate 19%.
- boards in the concrete floor have been cemented over (old sump pit?). Visible board is saturated with water.
- open hole through rim joist (location of former sump discharge?)
- poorly sealed air/vapour barrier at rim joist; missing insulation
- open floor drain used as washer discharge
- dryer: long winding flex duct

*Main Floor*
- forced air system: only a few returns, room doors not undercut
- kitchen range hood recirculating but exhaust plate not removed so fan blows air straight back down onto the range
- slight waterstain at base of living room window
- bottom of dining room window not insulated, airsealed or finished
- new waferboard and drywall over original drywall (visible only under dining room window
- underside of floor sheathing black under toilet
- measured relative humidity: basement 55%; kitchen 47%; bathroom 44%

Figure 4:
House A-41, Constricted Water Hose, Sump Pit Cemented Over, Black Framing



**Recommendations**

*Key Points:* This house exhibits many signs of ineffective protection from water penetration as well as almost non-existent ventilation. The saturated wood buried in the basement floor is a serious mold concern as is the exposed basement wall framing which shows no signs of drying in place. Air quality improvement in this house requires removal of mold amplification sites; mold clean-up; elimination of environmental tobacco smoke; protection from water leakage or back-up; improved ventilation; and dehumidification. Sample for mold periodically.

*Low Cost Recommendations*

1. Follow the general guidelines for homeowners listed in this report and in relevant CMHC literature. In particular, ban smoking in the house.
2. Remove the saturated wood which is partly buried in the basement floor. Clean up any mold following the CMHC booklets *Clean-up Procedures for Mold in Houses* and *Toxic Mold Clean-up Procedures*.
3. Strip out and discard the wet framing which has been exposed along the bottom half of the foundation wall. Thoroughly clean the concrete wall and floor with a bleach cleanser according to the above booklet. (See primary recommendation in General Recommendations.)
4. Repair the roof. Replace any missing shingles.
5. Patch any foundation snap-tie holes, wall cracks or floor cracks from the inside.

6. Provide a drain connection for the laundry tub to the house plumbing drain system.

7. Install a retrofit rubber backwater valve in the floor drain. Disinfect the floor drain periodically with a bleach and water solution.

8. Investigate the black floor sheathing under the toilet. If the toilet flange is leaking, repair it. Clean up any visible mold.

9. Repair the exterior siding to prevent water leaks. Patch the stucco where it has deteriorated. Patch the rough concrete sill under the basement window. Install a drip cap over the side entrance. Caulk around all windows and doors.

10. The bathroom exhaust duct does not terminate on the exterior of the roof, soffit or siding. Vent the bathroom exhaust directly outside, as listed in general recommendations. (See medium cost #4 and higher cost #2).

11. Vent the kitchen range hood directly outside, as listed in general recommendations.

12. Extend the eavestrough downspouts away from the foundation.

13. Replace the dryer flex duct with aluminum duct. Seal all joints with aluminum duct tape.

14. Replace the fibreglass furnace filter with an electrostatic pleated filter. Maintain periodically.

15. Complete the insulation, air/vapour barrier and sill at the bottom edge of the dining room window.

*Medium Cost Recommendations*

1. Monitor the condition of the remaining basement wall insulation. At any sign of water damage or mold, open up the wall cavity and check. If any mold is found, discard the contaminated materials and clean the wall with a bleach cleanser. Ultimately, if mold problems persist, it may be necessary to remove all basement interior insulation and framing and insulate on the exterior from the top of the foundation wall to 2 feet below finished grade using extruded polystyrene covered with a protective foundation coating and drip cap. (See higher cost #1)

2. Install a new sump pit and pump connected to the underslab drainage tiles. If no drainage under the slab exists, install perimeter drainage tile under the floor on the inside of the foundation wall (higher cost).

3. Raise and slope the grade immediately adjacent to the foundation.

4. Upgrade the bathroom exhaust fan and install sheet metal duct directly to the outside as noted in general recommendations. (See higher cost #2).

5. Dehumidify the basement as required (particularly in summer) with a portable dehumidifier.

6. Seal the air/vapour barrier over the fibreglass insulation in the joist spaces along the rim joist.

7. Undercut necessary room doors to provide return air delivery to the central returns. Run the furnace fan as continuously as possible to provide better air circulation.

*Higher Cost Recommendations*

1. Excavate and waterproof the exterior of the foundation walls. Install full height free-draining exterior insulation. Install perimeter drainage connected to the sump pit or sewer drainage system. Install a waterproofing membrane over the present

floor and pour a new concrete topping slab. (Note: this does not completely resolve the connection at the floor/wall interface.)

2. Install a balanced heat recovery ventilation system integrated with the existing forced air heating system. This type of system renders individual bathroom fans unnecessary. Install a two speed fan in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

## Investigation #4: House B-134

### Reported History

This wood frame bungalow with a full poured concrete foundation was built in 1987. The four current occupants have lived there since it was new. It is within the dike but is one of a number of houses with recurring seepage problems due to a high water table. Water enters through cracks in the basement floor which have previously been repaired with 'Quickset' concrete compound. The sump pump usually runs frequently from March through to January. If the electricity is off for one day, the basement floods. The water supply for this house is trucked in and stored in a cistern. Sewage flows to a holding tank and from there it is trucked to a community sewage lagoon.

The basement was stripped out due to water damage caused in April, 1997 when it flooded to a depth of 32 inches. It was re-insulated, but the materials were kept up 1 inch above the basement floor. It flooded to a depth of 1 inch in February, 1998.

An Enviro-Test Laboratories bulk sample taken from this house December 19, 1997 included a fungus identified in their report as *Penicillium*. A report by G. Woodward Restoration Services Ltd. to the Manitoba Emergency Management Organization, dated January 29, 1998, recommends sealing the foundation at joist level with caulking compound (inside and out) and removing and replacing seven window units with PVC units, in order to alleviate the existing mold conditions that were evident upon their inspection. According to the Health and Welfare Canada list dated February 26, 1998, this house has been identified as being contaminated with *Stachybotrys chartarum*. The undated remediation summary chart provided by the band reports that this house has been remediated as follows: strip out, power vac, power wash, clean ups, electrical, plumbing, cistern. Mold remediation apparently

included application of an unspecified anti microbial agent. The basement remains uninsulated and unfinished.

The occupants report that there is discussion by the band about lifting this house from its foundation and moving it to a drier location.

They also report the following:

- the south-east corner bedroom is cold when there is a south wind
- the attic hatch and exterior doors are drafty
- the house air is dry in winter
- water occasionally condenses on the window panes
- water penetrates two bedroom windows and the dining room window during heavy rains
- a dehumidifier is used to reduce dampness in summer and is emptied daily
- basement windows are opened in summer
- there is fuzzy growth or discolouration in the basement
- there is occasional condensation on the bathroom walls, floor or ceiling
- odours linger after cooking
- some occupants smoke in the house
- two occupants suffer from asthma, feeling worse in spring but better away from house

***Key Points:***

- High water table, basement floor 1.5 m (5 feet) below grade
- Basement flooded 32" deep, April, 1997
- Mold contamination (Penicillium) identified December, 1997
- Mold remediation January, 1998
- Basement flooded 1" deep February 1998

Figure 5:
House B-134, North-east

**Site Observations April 16, 1998**
Weather: sunny, +8C, approximately 45% RH

Some observations noted:
*Exterior*
- flat, poorly drained site
- poor grading against the foundation walls
- some roof shingles missing
- eavestrough downspouts direct water against the foundation
- the exterior finish, in good condition, is vinyl siding on the front and stucco on the other three sides
- two pieces of fascia missing on the gable ends
- a four inch hole which shows signs of weathering penetrates the stucco and rim joist and is open through to the basement (former dryer vent hole)
- dryer vent hood poorly attached
- fresh air intake hood located on the north wall adjacent to the driveway
- bathroom exhaust vent hood located on roof
- sump discharge line constricted at bend near wall, foundation wall wet

*Basement*
- the basement floor is about 5 feet below grade
- sump pump runs frequently
- holes drilled in the sealed sump pit cover serve as a floor drain
- a 2 foot by 3 foot patch of foundation coating on the west wall at the south end was apparently used to seal a major leak
- fresh air intake to return air of furnace has poorly sealed air/vapour barrier
- rim joist and underside of floor sheathing appear moldy in places
- underside of floor sheathing waterstained at front entrance
- main floor support beam shows evidence of mold and rot in north wall pocket
- heating supply duct is not attached to boot fitting through kitchen floor
- electric furnace, clean fibreglass filter, electric water heater
- significant air leakage through unused dryer vent penetration
- dryer flex duct constricted

*Main Floor*
- kitchen range hood vented outside; does not work
- bathroom ceiling exhaust vented through roof; does not work
- flooring underlay around toilet very spongy
- mold in caulking at edge of glass on all windows
- water damaged drywall under some windows
- living room window seal broken - condensation between panes
- floor and drywall water damaged in vicinity of front entrance
- measured relative humidity: basement 47%; kitchen 54%; bathroom 50%

**Recommendations**

*Key Points:*
- This house exhibits many signs of ineffective protection from leakage and ineffective ventilation. The high water table may well present a problem that is not practical to address properly through renovation of the existing deep basement. There is no place for the water to go.

- Mold is still a concern in this house. Unless the mold is proven to be eradicated, re-locating the wood-frame part of this house onto a new foundation will move the mold to that new location as well. Periodic sampling for mold is imperative.

- Concern about the high water table and continuing presence of mold is the perspective from which the following recommendations should be considered.

*Primary Recommendation*

Any house previously identified as moldy, particularly if that mold is *Stachybotrys chartarum*, must be thoroughly cleaned with

bleach, according to the directions in the CMHC booklets *Clean-up Procedures for Mold in Houses* and *Toxic Mold Clean-up Procedures.* Visible patches of mold must be disinfected with undiluted household chlorine bleach. The whole house, both basement and main floor, must be washed with the prescribed bleach cleanser (one part bleach, four parts water and a couple of drops of non-ammonia dishwashing detergent).

Any non-washable furnishings or possessions from moldy basements (e.g. sofas, cushions or mattresses, etc.) must be discarded. Any furnishings or possessions from the main floor must be removed from the house during the house cleaning. Any washable furnishings or possessions,(for example: curtains, wooden or plastic furniture) must be washed with a bleach cleanser before being returned to the house. Moldy furnishings, if returned to a house that has been de-contaminated, would be a source of mold spores.

Non-washable furnishings or possessions must be evaluated on a case-by-case basis. Moisture and mold can penetrate soft or upholstered furnishings. Any attempt to disinfect mold on the surface of such items is likely to be ineffective, particularly if the furniture had been exposed over a long period of time to conditions favourable to mold. In houses identified as contaminated with *Stachybotrys chartarum*, furnishings subjected to very moist conditions for several weeks should be suspected of being sources of re-contamination and consequently the recommendation is to discard them.

Both occupants and workers must be protected during mold clean-up and severely contaminated areas must be isolated from the rest of the house.

Sampling for mold must be undertaken a few days after the mold clean-up, before the houses are re-occupied. Periodic sampling for mold is recommended.

Check for any visible mold on the windows, rim joist, rim joist corners, underside of floor sheathing and in other damp locations. Strip and replace moldy window caulking when possible. Only replace windows for structural problems or irreparable leakage; not for surface mold.

***Low Cost Recommendations***

1. Follow the general guidelines for homeowners listed in this report and in relevant CMHC literature. In particular, ban smoking in the house.

2. Repair the roof. Replace any missing shingles.

3. Patch any holes in the exterior finish, particularly the open 4 inch hole which was the former location of the dryer exhaust.

4. Repair the weather seals on the dining room and two bedroom windows which have been reported as leaking water during heavy rains. (See medium cost #1)

5. Patch any foundation snap-tie holes, wall cracks or floor cracks from the inside. This has been attempted unsuccessfully in the past. This may become a medium cost measure depending on the extent of the repairs required and materials, such as an appropriate epoxy, used.

6. Install eavestrough downspout extensions to direct water away from the foundation.

7. Re-locate the fresh air intake away from the driveway. (See higher cost #3).

8. Continue to use the existing dehumidifier.

9. Re-attach any loose forced air supply or return branches to the boot fittings through the floor (for example, the kitchen supply).

10. Replace the dryer flex duct with aluminum duct. Seal all joints with aluminum duct tape.

11. Replace the fibreglass furnace filter with an electrostatic pleated filter. Maintain periodically.

*Medium Cost Recommendations*

1. If the dining room and two bedroom windows cannot be repaired, replace them.

2. Replace the perforated sump pit cover. Install a connecting floor drain with in-line backwater valve. Disinfect the floor drain periodically with a bleach and water solution.

3. Repair or replace the defective bathroom ceiling exhaust fan. Install sheet metal duct directly to the outside as noted in general recommendations. (See higher cost #3).

4. Repair or replace the defective range hood.

5. Replace the water damaged flooring around the toilet and at the front entrance. Clean up any discovered mold. Repair damaged drywall and sealing around the front entrance and below any windows.

6. Cut off and remove the rotting north end of the main floor support beam where it fits into the concrete wall pocket. Support the beam end with a jackpost.

7. Check the rim joist and edge of the floor sheathing, especially in the corners. Replace portions that are blackened with mold or rotten.

8. Insulate the foundation on the exterior from the top of the concrete wall to 2 feet below finished grade with extruded polystyrene covered with a protective foundation coating and drip cap. (See higher cost #1 and #2)

9. Raise and slope the grade immediately adjacent to the foundation.

10. Insulate between joist spaces along the perimeter of the rim joist. Insulate the cantilevered portion of floor framing completely. Install a sealed air/vapour barrier between joists at the inside face of the foundation wall.

11. Replace the living room glazing unit that has the broken seal.

12. Undercut necessary room doors to provide return air delivery to the central returns. Run the furnace fan as continuously as possible to provide better air circulation. (See higher cost #3).

*Higher Cost Recommendations*

Either on this lot or on another drier location that has community water and sewer services, do the following:

1. Build a new 4 foot high poured concrete crawlspace foundation with footings at, or very close to, the existing grade. The depth of the footings depends on the flood protection required versus the cost of backfill.

2. Dampproof the exterior of the foundation walls.

3. Install full height extruded polystyrene exterior insulation complete with a 2 foot wide horizontal extruded polystyrene skirt above the footings and perimeter drainage layer.

4. Install perimeter drainage, an under floor granular drainage layer and floor drain with backwater valve, all connected to a sealed sump pit.

5. Install underslab extruded polystrene insulation complete with a sealed 6mil poly air/vapour/moisture barrier.

6. Pour a minimum 3 inch floor slab.

7. Caulk all wall/floor junctions or contraction joints with urethane caulking.

8. Move the house onto the new foundation.

9. Provide a sloping grade around the foundation by backfilling with free draining granular material (if it is available at a reasonable price - at worst re-grade what is available on-site).

10. Use the existing stair well, as space permits, for a laundry/utility/water heater area with an access hatch to the crawlspace.

11. Install a horizontal electric furnace and heat recovery ventilation system in the crawlspace.

*Note*: it would be possible to use the existing foundation for this purpose if the house was moved off of it while it was filled with granular material and made into a crawlspace as above. However the disruption and costs might be impractical.

Alternatively, if a decision is made to retain the existing foundation:

1. Excavate and waterproof the exterior of the existing foundation walls. Install full height free-draining exterior insulation. Install perimeter drainage connected to the sump pit. Install a waterproofing membrane over the present floor and pour a new concrete topping slab. (Note: this does not completely resolve the connection at the floor/wall interface.)

2. Install a balanced heat recovery ventilation system integrated with the existing forced air heating system. This type of system renders individual bathroom fans and fresh air intakes unnecessary. Install a two speed fan in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

## Investigation #5: House G-16

### Reported History

This wood frame bungalow with a preserved wood foundation (PWF) is located on a separate parcel of land about 20 kilometres from the main Roseau River Anishinabe First Nation Reserve. Known as the Roseau River Rapids, there are sixteen houses in the 'North Rapids' and sixteen houses, including this one, in the 'South Rapids'.

Enviro-Test Laboratories swab samples taken from this house January 21, 1998 are reported as including nine colonies of *Stachybotrys chartarum* as well as *Penicillium, Aspergillus, Chaetomium, Phoma, Ulocladium, Alternaria, Acremonium and Cladosporium*, along with many bacteria and Trichoderma. This house was identified on the Health and Welfare Canada list dated February 26, 1998 as containing *Stachybotrys chartarum*. The undated remediation summary chart provided by the band reports that this house has been remediated as follows: strip out, power vac, power wash, pack out, electrical, plumbing. Mold remediation apparently included application of an unspecified anti microbial agent.

The house apparently contained a great deal of visible mold. The basement was also reported as being very cluttered.

***Key Points:***

- Severely mold contaminated, previous remediation for mold
- PWF basement, floor 1.5 m (5 feet) below grade

Figure 6:
House G-16, Front

**Site Observations April 17, 1998**
Weather: sunny, +8C, approximately 50% RH

At the time of inspection, this house was un-occupied and undergoing renovations. The foundation insulation and finish had been stripped out. On the main floor, the drywall had been removed but the insulation and poly air/vapour barrier remained. A three person crew was removing the vinyl flooring and underlay. New drywall was stacked on the living room floor. None of the workers were wearing respiratory protection.

Some observations noted:
*Exterior*

- generally flat land but slight grade away from house
- some negative grading adjacent to foundation
- a few roof shingles missing
- eavestrough downspouts torn off, no extensions seen
- exterior finish: vinyl front, stucco three sides; good condition
- bathroom exhaust hood located on roof
- no hood on the dryer exhaust port
- fresh air intake hood located on the south wall adjacent to the driveway
- range hood exhaust located on south wall
- boarded over bathroom window opening
- double glazed wood slider windows, insulated steel doors

*Basement*

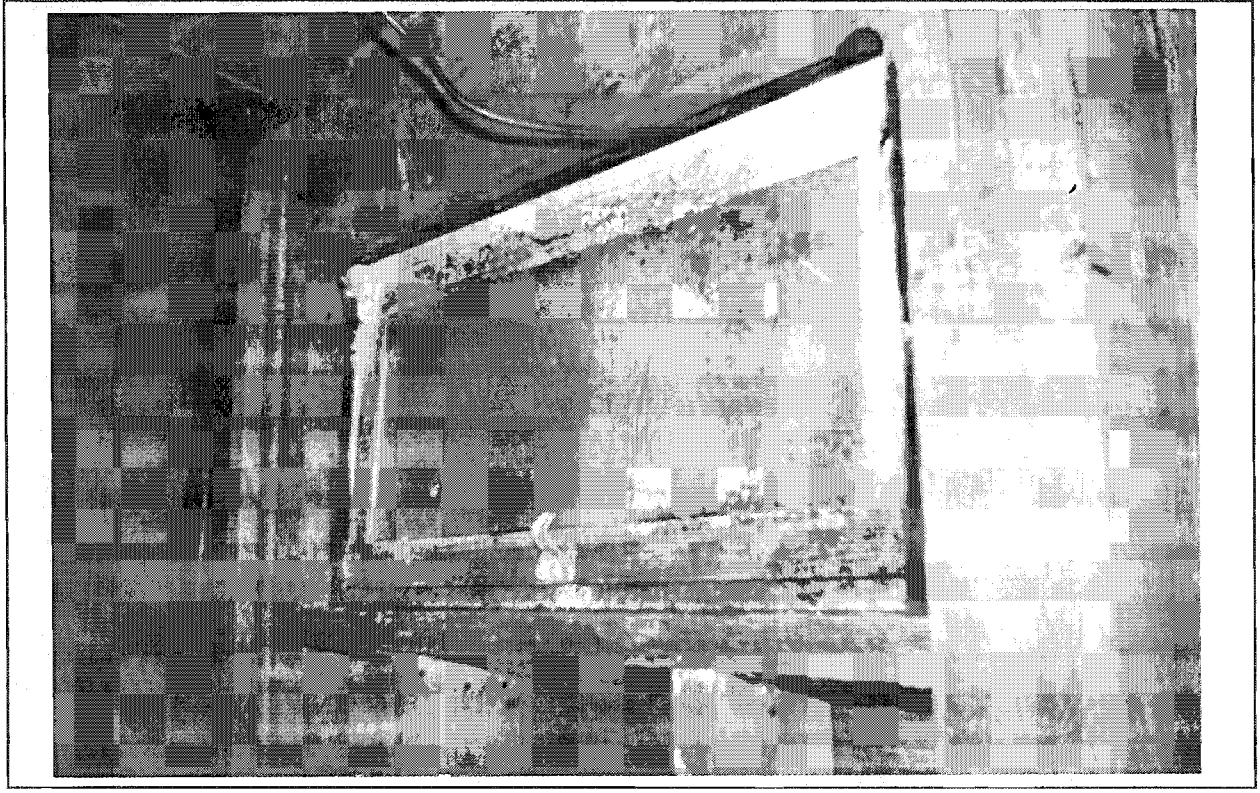
- basement floor about 5 feet below grade
- stripped-out PWF walls - finish and insulation removed
- electric furnace and water heater
- fibreglass furnace filter clean
- no sump pit
- floor drain contains standing water and visible mold
- visible mold on glass, sash and frame of single glazed basement windows

- leaking water pump on wood platform in south-east corner - leak is wetting adjacent PWF wall framing
- water pressure tank on mold-blackened waferboard platform
- water on PWF bottom plate in vicinity of north-east corner (seepage?)
- visible mold on rim joist in cantilevered floor area, west side, and at north-east corner.

*Main Floor*

- drywall stripped out; interior walls 2x4 framing; exterior walls and ceiling:framing, fibreglass insulation, polyethylene air/vapour barrier with joints overlapped but not sealed
- visible mold on interior surface of poly behind former location of kitchen cabinets and sink
- visible mold on every window
- evidence of water damage and mold in and around bathroom ceiling exhaust fan: on fan housing and in fibreglass ceiling insulation (poly not sealed to fan)
- water damage and rotted blocking below boarded-up bathroom window above tub
- visible mold on subfloor and underside of torn-up underlay in hall in front of bathroom
- measured relative humidity: basement 45%, main floor 42%

Figure 7:
House G-16, Basement Window Mold



## Recommendations

*Key Points:*

- Mold has permeated the structure.
- Previous remediation and renovation was ineffective.
- The preserved wood foundation shows evidence of ineffective waterproofing and drainage.

- This building must either be demolished or properly cleaned and re-located onto a new crawlspace foundation.

The intention of this site investigation was to investigate indoor air quality concerns for research purposes, not to assume the authority to stop renovation. However, because of the alarming mold presence in this house, the site workers were told immediately (about 1:15 pm) that there was a health risk attached to working without respiratory protection. The visible mold on the poly, windows and floor was pointed out. They were also informed that the new drywall stacked on the living room floor should not be applied and that further mold clean-up was necessary. The band flood control officer was also told in person (about 1:45 pm) that the house was moldy and renovations should cease. At about 4:45 pm, the band housing director was reached by telephone and was informed of the mold in this house and that renovations should not continue without further mold clean-up.

On April 23, 1998 at about 1:00 pm, a telephone call was received from the band housing director who related concern that the contractors had already installed and taped the new drywall. Again, he was told that the renovations should not have continued. He expressed concern about establishing who had the authority to stop the renovations. That question is beyond the scope of this report.

*Note*: Recommended preserved wood foundation construction techniques should have prevented the bottom plate of the foundation wall from getting wet (unless the source of the water was the leaking water pump or mold remediation power washing). For example, the pwf construction standard CAN/CSA-S406, requires "...a sump pit to a depth of at least 750mm (2.5 ft.) below the top of the granular drainage layer...". There is no sump pit in this house. Conformance to this standard also requires a 125mm (5 inch) granular drainage layer under the whole foundation extending 300mm (12 inches) past the footings. If this drainage layer is in place, without a sump pit, where does the water go?

***Primary Recommendations***

The evidence of mold seen in this house suggests that mold has permeated much of the existing structure. The extent of the mold contamination cannot be assessed or remediated without exposing every surface possible. As well, the preserved wood foundation would have to be excavated to assess the existing lack of drainage and waterproofing. It is difficult to imagine effective mold clean-up and affordable rehabilitation of this foundation. Therefore, the alternatives are as follows:

1. Discard the foundation by moving the main storey onto a new crawlspace foundation.

2. Discard the whole building.

Assess the cost of the following:

1. Completely strip out and discard all new drywall or other materials installed since the previous mold remediation. Strip out and discard all poly air/vapour barriers and fiberglass insulation. Discard the wood stands for the water pump and pressure tank. Dismantle all furnace ductwork. In short, expose every surface possible to enable effective cleaning.

2. Move the house off of the present foundation

3. Any part of the new house which will be used again, including ductwork, water pump, water tank, floor joists and all of the main storey must be subjected to a thorough mold clean-up according to the directions following below. It is important to perform this clean-up after moving off of the old contaminated foundation and before moving on to a new foundation.

4. Build a new crawlspace foundation.Move the house onto the new foundation. (See higher cost #1.)

5. Demolish and discard the old foundation.

6. Alternatively, assess the cost of demolishing the existing house completely and building a new one according to Part 4: New Construction in this report.

***Mold Clean-up:***

Any house previously identified as moldy, particularly if that mold is *Stachybotrys chartarum*, must be thoroughly cleaned with bleach, according to the directions in the CMHC booklets *Clean-up Procedures for Mold in Houses* and *Toxic Mold Clean-up Procedures*. Visible patches of mold must be disinfected with undiluted household chlorine bleach. The whole house, both basement and main floor, must be washed with the prescribed bleach cleanser (one part bleach, four parts water and a couple of drops of non-ammonia dishwashing detergent).

Any non-washable furnishings or possessions from moldy basements (e.g. sofas, cushions or mattresses, etc.) must be discarded. Any furnishings or possessions from the main floor must be removed from the house during the house cleaning. Any washable furnishings or possessions,(for example: curtains, wooden or plastic furniture) must be washed with a bleach cleanser before being returned to the house. Moldy furnishings, if returned to a house that has been de-contaminated, would be a source of mold spores.

Non-washable furnishings or possessions must be evaluated on a case-by-case basis. Moisture and mold can penetrate soft or upholstered furnishings. Any attempt to disinfect mold on the surface of such items is likely to be ineffective, particularly if the furniture had been exposed over a long period of time to conditions favourable to mold. In houses identified as contaminated with *Stachybotrys chartarum*, furnishings subjected to very moist conditions for several weeks should be suspected of being sources of re-contamination and consequently the recommendation is to discard them.

Both occupants and workers must be protected during mold clean-up and severely contaminated areas must be isolated from the rest of the house.

Sampling for mold must be undertaken a few days after the mold clean-up, before the houses are re-occupied. Periodic sampling for mold is recommended.

The following recommendations apply if some of the existing structure is retained:

***Low Cost Recommendations***

1. Follow the general guidelines for homeowners listed in this report and in relevant CMHC literature. In particular, ban smoking in the house.

2. Repair the leaking water pump. Install a concrete block base for the water pump and pressure tank. (See higher cost #1). Condensation from the pump or tank should not be allowed to soak into any material such as wood, waferboard or plywood, that would support mold growth.

3. Repair the roof. Replace any missing shingles.

4. Install eavestrough downspouts and extensions to direct water away from the foundation.

5. Slope the grade away from the foundation. (See higher cost #1).

6. Re-locate the fresh air intake away from the driveway. (See higher cost #2).

7. Install new aluminum dryer duct. Seal all joints with aluminum duct tape.

8. Replace the fibreglass furnace filter with an electrostatic pleated filter. Maintain periodically.

*Medium Cost Recommendations*

1. Replace any missing, broken or irreparable windows. (This could become a higher cost item).

2. Replace the bathroom ceiling exhaust fan. Install sheet metal duct directly to the outside. (See higher cost #2).

3. Install a new range hood vented directly outside.

4. When re-insulating, install a sealed air/vapour barrier, not one that is just overlapped at the joints.

5. When re-installing ductwork, seal all joints with water based duct seal. Ensure that all returns are fully ducted, not just lined joist spaces.

6. Dehumidify the crawlspace as required (particularly in summer) with a portable dehumidifier.

*Higher Cost Recommendations*

Either on this lot or on another drier location that has community water and sewer services, do the following:

1. Build a new 4 foot high poured concrete crawlspace foundation with footings at, or close to, the existing grade. The depth of the footings will depend on the flood protection required versus the cost of backfill.

2. Dampproof the exterior of the foundation walls.

3. Install full height extruded polystyrene exterior insulation complete with a 2 foot wide horizontal extruded polystyrene layer above the footings and perimeter drainage.

4. Install perimeter drainage, an under floor granular drainage layer and floor drain with backwater valve, all connected to a sealed sump pit.

5. Install underslab extruded polystrene insulation complete with a sealed 6mil poly air/vapour/moisture barrier.

6. Pour a minimum 3 inch floor slab.

7. Caulk all wall/floor junctions or contraction joints with urethane caulking.

8. Move the house onto the new foundation.

9. Provide a sloping grade around the foundation by backfilling with free draining granular material (if it is available at a reasonable price - at worst re-grade what is available on-site)

10. Use the existing stair well, as space permits, for a laundry/utility/water heater area with an access hatch to the crawlspace.

11. Install a horizontal electric furnace and heat recovery ventilation system in the crawlspace.

12. Install a balanced heat recovery ventilation system integrated with the existing forced air heating system. This type of system renders individual bathroom fans and fresh air intakes unnecessary. Install a two speed fan in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

*Note*

This was the first house investigated in which the drywall on the main floor had been removed and discarded, which allowed a far better visual inspection of the extent of the mold contamination and the effectiveness of the previous remediation.

The visual mold contamination in this building was still extensive at the time of investigation. Evidence of mold was seen in many places, including the basement window, on the rim joists, on the inside surface of the poly air/vapour barrier, in the fibreglass insulation surrounding the bathroom ceiling exhaust fan and between the underlay and the subfloor in the hall.

Since the investigation, the new drywall has been applied. There is no doubt that new drywall, paint and flooring will improve the appearance of this house. However, neither the mold contamination nor the underlying moisture problem have been adressed. This house will still be moldy when the cosmetic renovations are complete. Exactly when the mold contamination again becomes severe will depend on the availability of moisture. However, it is only a matter of time.

The visible mold contamination seen in this house while renovations were underway raises many questions concerning the extent of unseen mold contamination in other houses. How many renovated houses in this community look better but remain contaminated with mold?

All of the houses renovated for mold problems must be suspected to be still contaminated. The health risks to the occupants are not eradicated but are still either the same, diminished or delayed.

If this house needs further extensive mold remediation, then perhaps all houses that have ever been identified with mold contamination need further extensive remediation.

## Investigation #6: House B-116

### Reported History

This wood frame bungalow with a full poured concrete foundation was built between 1985 and 1990. It is within the dike but it is one of a number of houses with recurring seepage problems due to a high water table. It is equipped with a water cistern and sewage holding tank.

An Enviro-Test Laboratories swab sample taken from this house December 19, 1997 included fungi identified mainly as *Cladiosporum* along with a few *Penicillium.* A swab sample taken from a window the same day included fungi identified as *Cladiosporum.* According to the Health and Welfare Canada list dated February 26, 1998, this house has been identified as moldy.

The undated remediation chart provided by the band reports that this house has been remediated as follows: strip out, power vac, power wash, clean ups, electrical, plumbing, cistern. Mold remediation apparently included application of an unspecified anti microbial agent. The basement remains uninsulated and unfinished.

The occupants report the following:

- a humidifier is used to supplement the humidity level during the winter
- the basement has flooded
- odours linger after cooking
- one occupant may be experiencing health problems related to indoor air quality

***Key Points:***

- Basement subject to flooding, basement floor 1.5 m (5 feet) below grade
- Previous mold remediation

Figure 8:
House B-116, Front

**Site Observations April 16, 1998**
Weather: sunny, +10C, approximately 45% RH

Some observations noted:

*Exterior*

- flat, damp, poorly drained site
- poor grading adjacent to foundation walls
- eavestrough downspouts direct water against the foundation
- the exterior finish, in good condition, is vinyl siding on the front and stucco on the other three sides
- bathroom ceiling exhaust hood on roof
- dryer exhaust hood, sump discharge line and fresh air intake on north wall; intake slightly clogged

*Basement*

- basement floor about 5 feet below grade.
- a moldy, sewer smell noticeable
- pools of standing water up to 1 inch deep; basement floor not sloped to sump pit
- holes drilled in sump pit cover
- looks and smells of sewage in floor drain
- sump pump runs frequently
- wall framing and insulation stripped out
- dryer vent, sump line penetrations through rim joist not sealed
- 5 inch insulated flex duct for fresh air intake to return trunk - poorly sealed air/vapour barrier
- dryer flex duct hanging - washer and dryer previously removed
- visible mold on rim joist, especially north-east and north-west corners (some wood rot)
- mold and water damage on windows
- new electric furnace hung 20 inches from floor
- clean fibreglass furnace filter
- heating duct not attached to boot fitting through bedroom floor
- electric water heater

- electrical panel on original plywood backing

*Main Floor*

- all rooms have painted drywall and sheet vinyl flooring
- visible mold in caulking at edge of every window
- visible mold on spongy floor underlay in front of kitchen sink
- evidence of water damage in kitchen cabinet under sink
- waterstains at wall/ceiling junction in kitchen and dining room
- visible mold at floor/wall junction beside bathroom tub
- tubsurround not well fixed to wall
- kitchen range hood vented outside
- bathroom ceiling exhaust fan vented through roof
- measured relative humidity: basement 60%, kitchen 60%, bathroom 56%

**Recommendations**

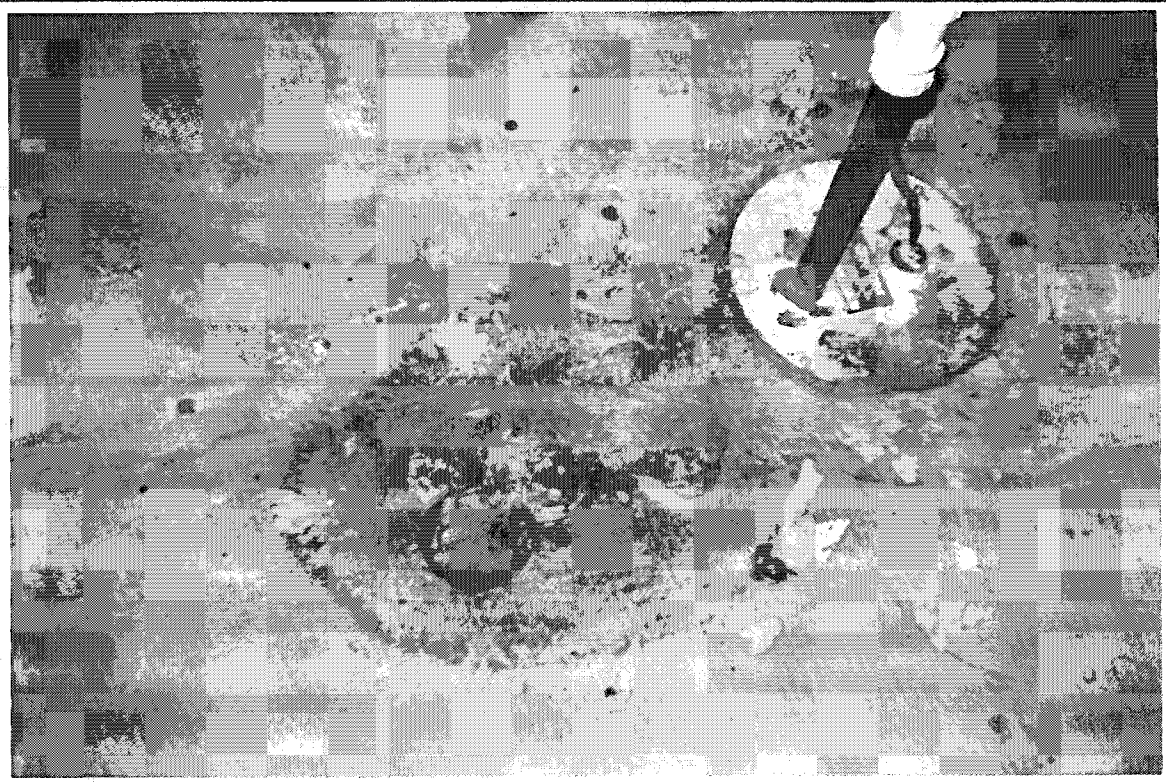
*Key Points:* Back-up of sewage in the floor drain is a serious sanitation issue.

The true extent of the mold contamination is undetermined. There is visible mold on the floor in front of the kitchen cabinets. How much mold is under or behind those cabinets?

This house exhibits many signs of ineffective protection from leakage and ineffective ventilation. The high water table may well present a problem that is not practical to address properly through improved waterproofing and drainage of the existing deep basement. There is no place for the water to go.

Concern about the presence of sewage, mold and the problem created by the high water table, is the perspective from which the following recommendations should be considered.

Figure 9:
House B-116, Basement Floor Drain



*Primary Recommendations*

1. Evacuate. The presence of sewage in the floor drain is a serious sanitation issue. As well, there is continuing presence of an undefined amount of mold.

2. The standing water in the basement and the sewage in the floor drain must be cleaned up. The source of these two problems must be stopped. Because of the high water table and lack of a drainage outlet, it may not be possible to stop the constant cycle of pumping water out of the sump pit and onto the surrounding ground, from where it contributes to the water seeping into the foundation again.

3. If it is not possible to stop the seepage into the basement, the house must be relocated onto a new crawlspace foundation (see higher cost #1). However, the extent of the mold on the main floor must be determined first. If the mold is as pervasive as suspected, it may not be worthwhile to strip out, clean and renovate the main floor.

4. Clean up mold as follows:

Any house previously identified as moldy, particularly if that mold is *Stachybotrys chartarum*, must be thoroughly cleaned with bleach, according to the directions in the CMHC booklets *Clean-up Procedures for Mold in Houses* and *Toxic Mold Clean-up Procedures*. Visible patches of mold must be disinfected with undiluted household chlorine bleach. The whole house, both basement and main floor, must be washed with the prescribed bleach cleanser (one part bleach, four parts water and a couple of drops of non-ammonia dishwashing detergent).

Any non-washable furnishings or possessions from moldy basements (e.g. sofas, cushions or mattresses, etc.) must be discarded. Any furnishings or possessions from the main floor must be removed from the house during the house cleaning. Any washable furnishings or possessions,(for example: curtains, wooden or plastic furniture) must be washed with a bleach cleanser before being returned to the house. Moldy furnishings, if returned to a house that has been de-contaminated, would be a source of mold spores.

Non-washable furnishings or possessions must be evaluated on a case-by-case basis. Moisture and mold can penetrate soft or upholstered furnishings. Any attempt to disinfect mold on the surface of such items is likely to be ineffective, particularly if the furniture had been exposed over a long period of time to conditions favourable to mold. In houses identified as contaminated with *Stachybotrys chartarum*, furnishings subjected to very moist conditions for several weeks should be suspected of being sources of re-contamination and consequently the recommendation is to discard them.

Both occupants and workers must be protected during mold clean-up and severely contaminated areas must be isolated from the rest of the house.

Sampling for mold must be undertaken a few days after the mold clean-up, before the houses are re-occupied. Periodic sampling for mold is recommended.

Visible mold has been noted in the caulking at the edge of every window, along the rim joist, on the kitchen floor and at the floor/wall junction in the bathroom. The extent of the mold, particularly under the kitchen cabinets, must be determined.

The following recommendations apply to the main floor, if it is retained, and to the basement if it is retained, although retaining the basement is not advised.

*Low Cost Recommendations*

1. Remove the standing water from the basement, if possible.

2. Clean and disinfect the floor drain and sump pit according to the CMHC booklet *Cleaning Up Your House After a Flood.* Replace the perforated sump pit cover with a sealed cover.

3. Install a retrofit rubber backwater valve in the floor drain. Disinfect the floor drain periodically with a bleach and water solution.

4. Patch any foundation snap-tie holes, wall cracks or floor cracks from the inside. This may become a medium cost measure depending on the extent of the repairs required and materials, such as an appropriate epoxy, used.

5. Follow the general guidelines for homeowners listed in this report and in relevant CMHC literature. In particular, ban smoking in the house.

6. Install eavestrough downspout extensions.

7. Replace the dryer flex duct with aluminum duct. Seal all joints with aluminum duct tape.

8. Re-attach any loose forced air supply ducts to their boot fittings.

9. Replace the fresh air intake flex duct to the return air trunk of the furnace with sheet metal duct complete with insulation and sealed air/vapour barrier.

10. Ensure good return air delivery to the central returns by undercutting necessary room doors. Run the furnace fan as continuously as possible to provide better air circulation.

*Medium Cost Recommendations*

1. Remove the concrete floor along the perimeter. Install perimeter drain tile leading to the sump pit. Install a waterproofing membrane over the present floor and pour a new concrete topping slab. (Note: this does little to resolve wall leaks. This is also only a medium cost relative to the higher cost recommendations following. This will be expensive.)

2. Replace any rotted wood in the rim joist. Seal around all penetrations.

3. Insulate the foundation on the exterior from top of the concrete wall to 2 feet below finished grade with extruded polystyrene covered with a protective foundation coating. (See higher cost #2 for more effective measures.)

4. Raise and slope the grade adjacent to the foundation.

5. Install insulation and a sealed air/vapour barrier in the joist spaces along the inside face of the rim joist, from the underside of the floor sheathing to the top of the foundation wall.

6. Alternatively, while insulating the foundation on the exterior, remove the exterior finish up to the top of the floor framing and insulate that area on the exterior in the same manner that the foundation is being insulated.

7. Dehumidify the basement as required (particularly in summer) with a portable dehumidifier.

8. Replace the boarded-up basement window with a minimum double glazed thermal unit.

*Higher Cost Recommendations*

Either on this lot or on another drier location that has community water and sewer services, do the following:

1. Build a new 4 foot high poured concrete crawlspace foundation with footings at, or close to, the existing grade. Depth of the foundation below grade depends on the flood protection required versus the cost of backfill.

2. Dampproof the exterior of the foundation walls.

3. Install full height extruded polystyrene exterior insulation complete with a 2 foot wide horizontal extruded polystyrene layer above the footings and perimeter drainage.

4. Install perimeter drainage, an under floor granular drainage layer and floor drain with backwater valve, all connected to a sealed sump pit.

5. Install underslab extruded polystrene insulation complete with a sealed 6mil poly air/vapour/moisture barrier.

6. Pour a minimum 3 inch floor slab.

7. Caulk all wall/floor junctions or contraction joints with urethane caulking.

8. Move the house onto the new foundation.

9. Provide a sloping grade around the foundation by backfilling with free draining granular material (if it is available at a reasonable price - at worst re-grade what is available on-site).

10. Use the existing stair well, as space permits, for a laundry/utility/water heater area with an access hatch to the crawlspace.

11. Install a horizontal electric furnace and heat recovery ventilation system in the crawlspace.

*Note*: it would be possible to use the existing foundation for this purpose if the house was moved off of it while it was filled with granular material and made into a crawlspace as above. However the disruption and costs might be impractical.
Also: the mold must be eradicated from the house, furnishings and possessions. Otherwise it will just travel to the new foundation.

Alternatively, if a decision is made to retain the existing foundation:

1. Excavate and waterproof the exterior of the foundation walls. Install full height free-draining exterior insulation. Install perimeter drainage connected to the sump pit. Install a waterproofing membrane over the present floor and pour a new concrete topping slab. (Note: this does not completely resolve the connection at the floor/wall interface.)

2. Install a balanced heat recovery ventilation system integrated with the existing forced air heating system. This type of system renders individual bathroom fans and fresh air intakes unnecessary. Install a two speed fan in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

## Investigation #7: House D-50

### Reported History

This wood frame raised bungalow with a shallow poured concrete foundation was built in 1981. It is outside the dike. Although the sequence of events is not totally clear, apparently, according to the homeowner, an extensive area of black mold was discovered on the panelling in the north-west corner of the finished basement in January of 1997. This was identified as *Stachybotrys chartarum.* A roof leak had enabled water to leak down the northwest corner in the wall cavity. That corner of the building was stripped out. For approximately ten feet in each direction from the corner, the foundation frame 'pony' wall (the bottom half is concrete and the top half is frame) was discarded and re-built. The basement was stripped out, cleaned and renovated with new insulation and drywall. Also for about eight feet in each direction from the corner, the master bedroom on the main floor was stripped out and cleaned, and new siding, insulation and interior drywall were applied (It is not clear whether the main floor framing was discarded and rebuilt).

In April of 1997, because the electrical power was shut off, the sump pump was not operating and the basement flooded to a depth of 3 inches with clear water which seeped up through cracks in the floor. Following the flood, drywall, insulation and studs were stripped out and the basement was cleaned. New framing was installed over the concrete wall and both the lower and upper parts of the wall were re-insulated and finished with drywall.

A report by KNH Sawatzky and Associates (1995) Ltd. Structural Engineering Consultants, dated August 12, 1997, notes that the foundation is structurally viable pending remedial repairs and recommends a new permanent ring dike around this property.

An Enviro-Test Laboratories swab sample taken from this house December 18, 1997 included colonies identified as 50% bacteria, 41% *Penicillium*, 6% *Stachybotrys chartarum* and 2% *Chaetomium.*

A report from G. Woodward Restoration Services Ltd. to the Manitoba Emergency Management Organization, dated January 29, 1998, recommends sealing the foundation at joist level with caulking compound and fillers (inside and out); removal and replacement of 7 window units with PVC units; and removal and replacement of the woodburning attachment for the furnace, in order to alleviate the existing mold conditions that were evident upon their site inspection.

According to the Health and Welfare Canada list dated February 26, 1998, this house was identified as being contaminated with *Stachybotrys chartarum.* The basement was stripped out again. The undated remediation summary provided by the band reports that this house has been remediated as follows: strip out, power vac, power wash, clean ups, electrical, plumbing, cistern. Mold remediation apparently included application of an unspecified anti microbial agent. The basement remains uninsulated and unfinished.

The occupants report the following:

- furniture and possessions were not removed from the basement but were moved from one end to the other while the power washing was underway
- a couch which was cleaned during remediation was discovered to be full of drywall dust
- six people live in this home
- water condenses on window panes occasionally
- the present windows are original to the house
- condensation has occasionally been observed on walls in the basement and bathroom

- condensation sometimes leaks back down through bathroom ceiling exhaust fan in winter
- a portable air conditioner is used in the dining room in summer
- sewage odour from pipe in basement
- septic field near river is below the raised grade surrounding the house; probably flooded, contaminating standing water at rear of house
- at least one occupant smokes in the house
- previous owner kept 3 dogs in the house
- some main floor rooms were previously carpetted
- two occupants, ages seven and ten, have asthma and feel worse in winter

***Key Points:***

- Original *Stachybotrys chartarum* contamination due to roof leak
- Shallow foundation, basement floor less than 1m (3.3 feet) below grade
- Outside the dike, flooded April, 1997
- Identified as *Stachybotrys chartarum* contaminated again in December 1997
- Further remediation in winter/spring 1998

Figure 10:
House D-50, South-east

**Site Observations April 18, 1998**
Weather: sunny, +4C, +/-80%RH

Some observations noted:
*Exterior*

- building site grade raised above surrounding area, good slope
- house: wood frame raised or split entry bungalow
- exterior finish prefinished hardboard 3 sides, vinyl north end
- hardboard siding buckled at main floor rim joist level
- a few missing shingles
- eavestroughs, no downspouts
- west wall: dryer exhaust hood, fresh air intake (partly clogged) to the return air trunk of the furnace

- bathroom exhaust vented through roof
- swamp at south end, river at west side
- sewage smell at west side
- north side inaccessable - trailer tight to building
- insulated metal chimney

*Basement*

- basement walls bottom half poured concrete, top half frame with waferboard or plywood sheathing and siding
- basement walls uninsulated and unfinished
- basement floor less than 1 metre (3 feet) below grade
- cracks in concrete floor
- floor drain open - contains debris
- water pump on piece of plywood - blackened - evidence of mold
- mold blackened waferboard sheathing at rim joist, especially on the east side (joists are floor trusses -2x3 top and bottom chords, intermediate metal webs)
- long flex duct to dryer
- some supply air ducts not attached to boot fittings
- wood/electric forced air furnace - no evidence of backdrafting
- no furnace filters
- some firewood stored inside
- many stored possessions and furnishings

*Main Floor*

- all drywalled walls and ceilings, new tile floors
- kitchen recirculating range hood not working
- main bathroom ceiling exhaust fan ineffective
- main bath - new toilet, new shower surround, no visible mold
- ensuite half bath - no window, no exhaust fan
- triple glazed Loewen wood frame windows, most in good condition - no visible mold noticed
- master bedroom window 1 broken pane
- living room window - condensation between panes, seal broken
- measured relative humidity: basement 50%, kitchen 52%, bathroom 49%

**Recommendations**

***Key Points:*** Although there is less visible mold in this house than in some of the others investigated, known contamination with *Stachybotrys chartarum* requires extra care. Viable *Stachybotrys chartarum* mold in this house remains a possibility, particularly since furnishings were apparently not removed from the house during previous mold remediation. The potential re-contamination must be adressed.

***Primary Recommendation***

Any house previously identified as moldy, particularly if that mold is *Stachybotrys chartarum*, must be thoroughly cleaned with bleach, according to the directions in the CMHC booklets *Clean-up Procedures for Mold in Houses* and *Toxic Mold Clean-up Procedures*. Visible patches of mold must be disinfected with undiluted household chlorine bleach. The whole house, both basement and main floor, must be washed with the prescribed bleach cleanser (one part bleach, four parts water and a couple of drops of non-ammonia dishwashing detergent).

Any non-washable furnishings or possessions from moldy basements (e.g. sofas, cushions or mattresses, etc.) must be discarded. Any furnishings or possessions from the main floor must be removed from the house during the house cleaning. Any washable furnishings or possessions,(for example: curtains, wooden or plastic furniture) must be washed with a bleach cleanser before being returned to the house. Moldy furnishings, if returned to a house that has been de-contaminated, would be a source of mold spores.

Non-washable furnishings or possessions must be evaluated on a case-by-case basis. Moisture and mold can penetrate soft or upholstered furnishings. Any attempt to

disinfect mold on the surface of such items is likely to be ineffective, particularly if the furniture had been exposed over a long period of time to conditions favourable to mold. In houses identified as contaminated with *Stachybotrys chartarum*, furnishings subjected to very moist conditions for several weeks should be suspected of being sources of re-contamination and consequently the recommendation is to discard them.

Both occupants and workers must be protected during mold clean-up and severely contaminated areas must be isolated from the rest of the house.

Sampling for mold must be undertaken a few days after the mold clean-up, before the houses are re-occupied. Periodic sampling for mold is recommended.

***Low Cost Recommendations***

1. Discard the plywood under the water pump.
2. Leave the basement frame walls and rim joist uninsulated until fall.
3. Repair the roof. Replace any missing shingles. Repair the buckled siding. Ensure that the exterior finish will shed rainwater effectively.
4. Patch any foundation snap-tie holes, wall cracks or floor cracks from the inside. This may become a medium cost measure depending on the extent of the repairs required and materials used.
5. Follow the general guidelines for homeowners listed in this report and in relevant CMHC literature. In particular, ban smoking in the house.
6. Install a retrofit rubber backwater valve in the basement floor drain. Disinfect the floor drain periodically with a bleach and water solution.
7. Store firewood outside.
8. Move the trailer to allow better airflow along the north wall.
9. Install eavestrough downspouts and extensions.
10. Clear any dust from the fresh air intake bug screen. Ensure that the duct is sheet metal and insulated with a sealed air/vapour barrier.
11. Re-attach any loose forced air supply ducts to their boot fittings.
12. Replace the dryer flex duct with aluminum duct. Seal all joints with aluminum duct tape.
13. Install electrostatic pleated furnace filters. Maintain periodically.

***Medium Cost Recommendations***

1. It is very difficult to effectively de-contaminate waferboard. Remove and replace the mold-blackened waferboard exterior wall sheathing surrounding the main floor rim joist framing. The siding in that area will have to be taken off to gain access to the sheathing.
2. Wait until fall for any sign of continued mold growth. If there is no sign of *Stachybotrys chartarum*, insulate the basement frame walls and the main floor perimeter joist spaces. Install a sealed air/vapour barrier from the underside of the floor sheathing to the top of the concrete foundation wall.
3. Improve the grade, where necessary, adjacent to the foundation wall. (See higher cost #2)

4. Upgrade the bathroom ceiling exhaust fan. Install sheet metal duct directly to the outside. Install a bathroom exhaust fan (preferably through the wall) in the ensuite bathroom. (See higher cost #3)

5. Exhaust the kitchen range hood outside.

6. Undercut necessary room doors to provide return air delivery to the central returns. Run the furnace fan as continuously as possible to provide better air circulation. (See higher cost #3).

7. Dehumidify the basement as required (particularly in summer) with a portable dehumidifier. Continue to use the portable air conditioner.

***Higher Cost Recommendations***

1. Install a new septic system or holding tank in a suitable location to eliminate flooding of the present system and groundwater contamination around the house.

2. Insulate the foundation on the exterior from the top of the concrete wall to at least 2 feet below finished grade with extruded polystyrene covered with a protective foundation coating.

3. Install a balanced heat recovery ventilation system integrated with the existing forced air heating system. This type of system renders individual bathroom fans and fresh air intakes unnecessary. Install a two speed fan in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

## Investigation #8: House D-1

### Reported History

This wood frame bungalow has apparently experienced both renovation and addition. It has a full poured concrete foundation under most of the house along with a poured concrete crawlspace with dirt floor under the east extension and south wing. It is outside the dike and was flooded up to the underside of the floor joists in April of 1997. In the summer of 1997, extensive interior renovations were performed. The occupants returned to the house in October, 1997.

On January 29, 1998 the occupants were evacuated due to the discovery that the house was contaminated with *Stachybotrys chartarum.* After the house was remediated, the occupants returned in late February, 1998.

A report by KNH Sawatzky and Associates (1995) Ltd. Structural Engineering Consultants, dated August 12, 1997, notes that the foundation is in good condition and can be salvaged. They recommend a ring dike around the property since the building has been added on to and it would not be practical to try to lift it. (There was discussion at a mold meeting at the band office April 15, 1998 concerning the expense of a ring dike and therefore the necessity of placing this house on an elevated foundation.)

An Enviro-Test Laboratories swab sample taken from this house December 18, 1997 included colonies identified as 65% *Penicillium* and 35% bacteria.

A report from G. Woodward Restoration Services Ltd. to the Manitoba Emergency Management Organization, dated January 29, 1998, recommends sealing the foundation at joist level with caulking compound and fillers (inside and out) in order to alleviate the existing mold conditions that were evident upon their site inspection.

According to the Health and Welfare Canada list dated February 26, 1998, this house was identified as being contaminated with *Stachybotrys chartarum*. The undated remediation summary provided by the band reports that this house has been remediated as follows: strip out, power vac, power wash, clean ups, electrical, plumbing, cistern. Mold remediation apparently includes application of an unspecified anti microbial agent. The basement remains uninsulated and unfinished.

The occupants report the following:

- eight people live in this home
- house air is dry in winter
- occasional condensation on window panes
- water comes in through walls or roof during heavy rain
- house damp and humid in summer
- frequent condensation on basement walls or floor
- floors over crawlspace cold
- odours linger after cooking
- bathroom fan slow to exhaust humidity, condensation runs back down in winter
- spiders and mice are a problem - rat poison is used in the house
- some occupants smoke in the house
- a cat is allowed indoors
- previous occupant kept 2 dogs indoors
- one occupant (age 7) suffers from asthma and nosebleeds; two occupants (ages 12 & 16) suffer from asthma and headaches; all are affected by moldy places and feel better outdoors than inside the home
- odours are more noticeable in the basement

***Key Points:***

- Outside the dike, flooded to the underside of the floor joists, April, 1997
- Extensive renovations, summer, 1997
- Identified as contaminated with *Stachybotrys chartarum*, January, 1998
- Mold remediation February, 1998

Figure 11:
House D-1, South

**Site Observations April 18, 1998**
Weather: sunny, +10C, +/-45%RH

Some observations noted:
*Exterior*
- immediate building site grade okay, top of slope to river (west side)
- damp low land to south and east
- dryer exhaust, exhaust hood on roof, no outside air intakes
- south gable end vent open; no protection from birds or bats
- plywood soffit waterstained, open vent holes; no protection from birds or bats
- wood fascia; waterstained
- roof and siding good condition
- eavestrough downspouts have no extensions

*Basement*
- poured concrete wall cracked especially west end of north wall, west wall and west end of south wall; water stains at snap-ties; efflorescence
- water seepage through wall crack in south-west corner
- unsealed sump pit with pressure treated wood cover - used as laundry and floor drain
- water pump on slightly damp wood base
- new electric furnace hung 20 inches from floor
- no furnace filter - filter port covered with grey duct tape
- dryer flex duct not attached to dryer (dryer in use)
- heating supply and return trunks through basement wall into crawlspace - leaving 3 inch by 8 inch gap through wall
- crawlspace hatch in south wall - waferboard cover (installed March 98 due to cold)

*Crawlspace*
- uninsulated poured concrete walls, +/-2 foot height
- dirt floor covered with unsealed poly - dusty
- construction debris still in crawlspace - boards, etc.
- live cat - crawlspace accessible from outside

*Main Floor*
- renovated, new drywall, paint, tile floors, good condition
- kitchen range hood recirculating
- bathroom ceiling exhaust ineffective, no window
- no heating supply duct to bathroom
- visible black mold on bathroom wall between toilet and tub
- small return air ducts in odd places (due to renovations?)
- return air ducts not attached through floor to registers in north-east bedroom and living room - both ducts and holes through floor open to crawlspace
- measured relative humidity: basement 43%, main floor 43%

**Recommendations**

***Key Points:*** Continued *Stachybotrys chartarum* contamination remains a concern. This house exhibits many signs of ineffective protection from leakage and ineffective ventilation. Re-locating this house to an elevated foundation is under consideration for flood reasons. This option would also be the wisest choice for indoor air quality reasons (see higher cost #1). Nevertheless, various recommendations following pertain to the existing foundation.

***Primary Recommendation***

Any house previously identified as moldy, particularly if that mold is *Stachybotrys chartarum*, must be thoroughly cleaned with bleach, according to the directions in the CMHC *booklets Clean-up Procedures for Mold in Houses* and *Toxic Mold Clean-up Procedures*. Visible patches of mold must be disinfected with undiluted household chlorine bleach. The whole house, both basement and main floor, must be washed with the prescribed

bleach cleanser (one part bleach, four parts water and a couple of drops of non-ammonia dishwashing detergent).

Any non-washable furnishings or possessions from moldy basements (e.g. sofas, cushions or mattresses, etc.) must be discarded. Any furnishings or possessions from the main floor must be removed from the house during the house cleaning. Any washable furnishings or possessions,(for example: curtains, wooden or plastic furniture) must be washed with a bleach cleanser before being returned to the house. Moldy furnishings, if returned to a house that has been de-contaminated, would be a source of mold spores.

Non-washable furnishings or possessions must be evaluated on a case-by-case basis. Moisture and mold can penetrate soft or upholstered furnishings. Any attempt to disinfect mold on the surface of such items is likely to be ineffective, particularly if the furniture had been exposed over a long period of time to conditions favourable to mold. In houses identified as contaminated with *Stachybotrys chartarum*, furnishings subjected to very moist conditions for several weeks should be suspected of being sources of re-contamination and consequently the recommendation is to discard them.

Both occupants and workers must be protected during mold clean-up and severely contaminated areas must be isolated from the rest of the house.

Sampling for mold must be undertaken a few days after the mold clean-up, before the houses are re-occupied. Periodic sampling for mold is recommended.

Visible mold was noted in the bathroom, on the wall between the toilet and tub.

***Low Cost Recommendations***

1. Follow the general guidelines for homeowners listed in this report and in relevant CMHC literature. In particular, ban smoking in the house.

2. Screen the gable end and soffit vents. Check the roof and exterior siding for any leakage points. Repair as necessary.

3. Discard the wooden water pump base.

4. Install a heating supply duct to the bathroom.

5. Re-attach any disconnected heating supply or return ducts to boot fittings through the floor.

6. Clean the debris from the crawlspace and install a sealed poly moisture barrier over the dirt floor.

7. Install eavestrough downspout extensions.

8. Ensure that the grade immediately adjacent to the foundation is sloped away from building.

9. Replace the dryer flex duct with aluminum duct. Attach it to the dryer. Seal the joints with aluminum duct tape.

10. Install an electrostatic pleated furnace filter. Maintain periodically.

***Medium Cost Recommendations***

1. An attempt can be made to patch any foundation snap-tie holes, wall cracks or floor cracks from the inside using an appropriate epoxy. Success is questionable. (See higher cost #1)

2. Install a sealed sump pit connected to the underslab drainage tiles. (See higher cost #1)

3. If underslab drainage is needed, trench the concrete floor along the perimeter. Install perimeter drain tile leading to the sump pit. Install a waterproofing membrane over the floor and pour a new concrete topping slab. This is only medium cost relative to the higher cost foundation leakage recommendations. This will be expensive. (See higher cost #1.)

4. Upgrade the bathroom ceiling exhaust fan. Install sheet metal duct directly to the outside. (See higher cost #3)

5. Upgrade the kitchen range hood. Install sheet metal duct as directly to the outside as possible.

6. Insulate the foundation, including the crawlspace, on the exterior from the top of the concrete wall to at least 2 feet below finished grade with extruded polystyrene covered with a protective foundation coating. Block off any crawlspace vents. (See higher cost #1 and #2)

7. Insulate the main floor joist spaces along the inside face of the perimeter rim joist. Install a sealed air/vapour barrier from the underside of the floor sheathing to the top of the foundation wall. Alternatively, while insulating the foundation on the exterior, remove the exterior finish up to the top of the floor framing and insulate that area on the exterior in the same manner that the foundation is being insulated. (See medium cost #6 and higher cost #1 and #2.)

8. Investigate the forced air system duct layout. Incorporate the crawlspace into the heated volume of the house. Ensure that there is balanced supply and return to all areas of the house.
9. Run the furnace fan as continuously as possible to provide better air circulation. (See higher cost #3)

***Higher Cost Recommendations***

Either on this lot or on another drier location that has community water and sewer services, do the following:

1. Build a new 4 foot high poured concrete crawlspace foundation with footings at, or close to, the existing grade. The depth of the footings will depend on the flood protection required versus the cost of backfill.

2. Dampproof the exterior of the foundation walls.

3. Install full height extruded polystyrene exterior insulation complete with a 2 foot wide horizontal extruded polystyrene layer above the footings and perimeter drainage.

4. Install perimeter drainage, an under floor granular drainage layer and floor drain with backwater valve, all connected to a sealed sump pit.

5. Install underslab extruded polystrene insulation complete with a sealed 6mil poly air/vapour/moisture barrier.

6. Pour a minimum 3 inch floor slab.

7. Caulk all wall/floor junctions or contraction joints with urethane caulking.

8. Move the house onto the new foundation.

9. Provide a sloping grade around the foundation by backfilling with free draining granular material (if it is available at a reasonable price - at worst re-grade what is available on-site)

10. Use the existing stair well, as space permits, for a laundry/utility/water heater area with an access hatch to the crawlspace.

11. Install a horizontal electric furnace and heat recovery ventilation system in the crawlspace.

*Note:* it would be possible to use the existing foundation for this purpose if the house was moved off of it while it was filled with granular material and made into a crawlspace as above. However the disruption and costs might be impractical.

Also, the mold must be eradicated from the house, furnishings and possessions. Otherwise it will just travel to the new foundation.

Alternatively, if a decision is made to retain this foundation:

1. Excavate and waterproof the exterior of the existing foundation walls. Install full height free-draining exterior insulation. Install perimeter drainage connected to the sump pit. Install a waterproofing membrane over the present floor and pour a new concrete topping slab. (Note: this does not completely resolve the connection at the floor/wall interface. It also doesn't resolve the flooding potential outside the dike.)

2. Install a balanced heat recovery ventilation system integrated with the existing forced air heating system. This type of system renders individual bathroom fans and fresh air intakes unnecessary. Install a two speed fan in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

# CONCLUSIONS FROM HOUSE INVESTIGATIONS

## Factors Contributing to Mold and Other Indoor Air Quality Problems

### Poor Site Drainage

Poor site drainage is the largest single contributing factor to the mold problems. It creates very difficult conditions in which to build houses with full basements. Prevention of groundwater entry into foundations is, in many cases, reliant upon the operation of sump pumps. If power to the pumps is lost, as it was in April, 1997, seepage of groundwater into many basements, even those located inside the dike, is almost inevitable. Sewage back-up is also a problem. It should be assumed that any basement that has flooded in the past is likely to do so again at some time in the future life of that building, despite any foundation waterproofing or drainage improvements.

### Original Building Construction Techniques

The depth into the ground of the existing foundations has certainly made them more prone to flooding. The foundation dampproofing and perimeter drainage are unknown but very suspect. Interior foundation insulation and finishing have created hidden cavities for mold growth along with more difficulty for mold clean-up. The likelihood of below grade water penetration is enhanced by eavestroughs without downspouts, downspouts without extensions and sunken backfill which has never been improved.

Poor construction has magnified problems. For example, evidence of mold growth along the inside face of the rim joist is common. The excessive water vapour in the air in the basements has been allowed to migrate through the insulation in the floor joist spaces along the perimeter of the building. Then it condenses on the cold inside face of the rim joist and provides a good site for mold growth. A sealed air/vapour barrier at the inside face of the insulation would minimize this problem. The only house with main storey walls and ceilings exposed (G-16) revealed air/vapour barriers overlapped but not sealed.

The installed mechanical ventilation in all houses is inadequate. The bathroom ceiling exhaust fans provide weak airflow. The ducting is suspect. Range hoods are often re-circulating rather than exhausting. In addition, many bathrooms have no opportunity for natural ventilation because they have no windows. Bathtubs have been poorly located at exterior walls and windows have been omitted. (Condensation on bathroom windows is not necessarily a sign that the windows themselves are a problem. It is a sign of excessive humidity condensing on the coldest available surface.)

### Inadequate Building Maintenance

In addition to the below grade problems, there are many instances of missing shingles, broken windows, poor sealing around windows and doors, and incomplete repairs. These can all lead to water penetration and possibly mold problems. For example, a roofing defect contributed directly to the original *Stachybotrys chartarum* contamination in D-50. Re-location of the dryer vent in B-134 did not include patching the former vent location through the rim joist, leaving a 4 inch open hole through to the inside. Many air supply ducts are not attached to boot fittings, minimizing air circulation.

## Current Mold Remediation

Of the eight houses investigated, one (A-39) had previously been deemed to have no visible mold. The Health and Welfare Canada list dated February 26, 1998, reports four of the

houses (D-1, D-50, G-16 and B-134) as contaminated with *Stachybotrys chartarum.* Two other houses (B-116 and A-33) are listed as moldy. Except for A-39, all of the other seven houses have been remediated for mold or flooding according to the undated remediation list provided by the band.

All eight houses continue to be a concern regarding mold contamination. There was visible mold in A-39, A-33, A-41, B-134, G-16, B-116 and D-1. There is also indirect evidence of mold in D-50, where there is black discolouration on the inside surface of the waferboard sheathing surrounding the floor frame and a report from the homeowner that not all basement furniture was removed during previous mold remediation. The house investigations performed for this report cannot confirm that mold remediation previously undertaken and currently being implemented, is effective. If these houses are representative of the other houses in the community, then all houses that have previously identified as contaminated with original *Stachybotrys chartarum* or any other molds must be considered to be still contaminated, whether they have been remediated or not.

## Current Renovations

Except for some improvements made to sump pits and floor drains, most of the other recent renovations seen are best described as cosmetic. They do nothing to resolve the underlying causes of recurring mold problems and poor indoor air quality.

## Future Projection

Unless there is a dramatic shift in focus, the current cycle of mold contamination, remediation and renovation should be expected to continue repeatedly, with no end in sight.

## Part 1: Mold Remediation

Clean up mold according to the procedures and precautions contained in the CMHC *booklets Clean-up Procedures for Mold in Houses, Toxic Mold Clean-up Procedures* and *Cleaning Up Your House After a Flood.* This clean-up protocol must be followed thoroughly. Briefly, the following steps must be taken:

### 1. Identification of Mold Contaminated Houses

Identify the contaminated houses. Any house that has previously been identified by visual inspection or sampling as being contaminated with mold must be thoroughly cleaned up again. Any house that has not been previously identified should be inspected again. Look in any place that might have been damp: the edges of windows; around any kitchen or bathroom fixtures (including the ceiling exhaust fan); around water pumps or pressure tanks; in floor drains or sump pits; under stored items in the basement; in any known water leakage areas; behind any unsealed rim joist insulation; at the back of closets.

Better documentation of sampling is needed. Exact sampling locations are required.

The extent of the necessary cleaning depends upon the extent of the mold contamination and the identification of the molds present.

### 2. Primary Recommendation

Any house previously identified as moldy, particularly if that mold is *Stachybotrys chartarum*, must be thoroughly cleaned with bleach, according to the directions in the CMHC booklets *Clean-up Procedures for Mold in Houses* and *Toxic Mold Clean-up Procedures.* Visible patches of mold must be disinfected with undiluted household chlorine bleach. The whole house, both basement and main floor, must be washed with the prescribed bleach cleanser (one part bleach, four parts water and a couple of drops of non-ammonia dishwashing detergent).

Any non-washable furnishings or possessions from moldy basements (e.g. sofas, cushions or mattresses, etc.) must be discarded. Any furnishings or possessions from the main floor must be removed from the house during the house cleaning. Any washable furnishings or possessions,(for example: curtains, wooden or plastic furniture) must be washed with a bleach cleanser before being returned to the house. Moldy furnishings, if returned to a house that has been de-contaminated, would be a source of mold spores.

Non-washable furnishings or possessions must be evaluated on a case-by-case basis. Moisture and mold can penetrate soft or upholstered furnishings. Any attempt to disinfect mold on the surface of such items is likely to be ineffective, particularly if the furniture had been exposed over a long period of time to conditions favourable to mold. In houses identified as contaminated with *Stachybotrys chartarum*, furnishings subjected to very moist conditions for several weeks should be suspected of being sources of re-contamination and consequently the recommendation is to discard them.

Both occupants and workers must be protected during mold clean-up and severely contaminated areas must be isolated from the rest of the house.

Sampling for mold must be undertaken a few days after the mold clean-up, before the houses are re-occupied. Air samples must be taken in different parts of the house. Swab samples of visible mold are also required. Periodic sampling for mold is recommended.

### 3. For Slight Visible Mold

For slight mold contamination, as discovered in the first house investigated in this study, clean-up of the visible mold and potential mold growth sites is required. In that house, an un-identified mold was found on the edges of the windows and in the caulking at the back edge of the bathroom vanity. Clean up with an application of straight household bleach directly onto the mold. Use a bleach cleanser composed of one part bleach, four parts water and a drop of non-ammonia dish detergent to wipe surfaces surrounding the mold. Dead mold residue can still affect health so, as much as possible, it must be physically removed. In some cases, the moldy surface of caulking can be stripped out with a knife. The surrounding area should still be cleaned, as noted above, before new silicone caulking is applied. Further inspection of any possible mold sites is necessary.

Any evidence of mold is unacceptable! Conduct a thorough top-to-bottom 'spring cleaning'; wash down walls, ceilings and floors with the recommended bleach cleanser. Follow the procedures from the booklets. Show interested homeowners how to identify and clean up mold themselves.

### 4. Re-inspection

There are dangerous mold problems in this community, as documented in the following: the Enviro-Test Laboratories sample analyses; the Health and Welfare Canada list of mold contaminated houses dated February 26, 1998; the "mold meeting" minutes from January 14 to March 23; and the eight investigations conducted for this report. Frequent re-inspection for visible mold is recommended for every home. Any house which has been previously identified as moldy , particularly if that mold was *Stachybotrys chartarum*, should be re-tested for mold periodically.

## Part 2: Renovation of Houses to Prevent Recurring Problems

*Note: General recommendations to improve indoor air quality and prevent recurring mold problems are offered. These recommendations are divided into measures that can be done at lower cost and at higher cost. More than one recommendation which serves a particular purpose may be found in one or both categories. These variations are offered as options. The differences between them are largely based on cost and effectiveness. For example, repairing a broken bathroom exhaust fan, upgrading to a more effective fan and installing a heat recovery ventilator which exhausts air from the bathroom all serve a similar purpose but the cost and effectiveness of each is different.*

### Strategy

Any mold clean-up, even according to the procedures listed above, will be wasted if the underlying causes of the mold contamination are not adressed. With the right temperature conditions, availability of moisture and availability of food (almost anything organic); the mold will return. Temperature conditions that are right for people are also often right for mold. Food for mold can be minimized but not eliminated. The only factor that we have some opportunity to control effectively is moisture. The following recommendations are intended to change the conditions in the existing houses which facilitate mold contamination and other indoor air quality problems:

1. For the building envelope:
- Stop water leaks through any part of the building envelope; roof, exterior above grade walls and foundation.
- Reduce cold surfaces which can lead to condensation and mold growth. The method chosen should not create more hidden cavities which can provide new areas for mold growth and difficult areas to remediate.
- Gain more control over random air leakage, leading to more control over the indoor air.

2. For the ventilation and mechanical systems:
- Manage the relative humidity.
- Exhaust stale air and supply fresh air.
- Circulate the fresh air to all living spaces.

3. Renovate with the perspective that the house is a system where the building envelope, mechanical system and lifestyle practices of the occupants all have effects on each other.

One serious defect in the recent renovation of moldy houses being done in this community, is the practice of framing and insulating basements on the interior, which provides a hidden cavity for moisture and mold problems. It also creates extra difficulty and expense for remediation. Any basement that has flooded in the past may very well flood again in the future, despite renovations designed to seal against water leakage and improve drainage. Therefore, re-insulating any previously flooded basements on the inside is strongly discouraged. Insulating on the outside will allow much easier remediation of any future flooding problems.

Shallow foundations in split entry bungalows like D-50 can be insulated between the studs in the upper frame portion but should be insulated on the exterior of the concrete portion. Framing in rooms and using these basements as living space is a gamble which must be evaluated for each individual case.

The houses with full foundations tend to have the basement floors about 1.5 metres (5 feet) below grade. Use of these basements as finished living space is strongly discouraged.

### Building Envelope Renovations

*Lower Cost Foundation Options*

1. Ensure that sump pits with sealed covers and basement floor drains with backwater valves are installed, and that any pumps work as designed. If the sump pits are not connected to outside perimeter or under-floor drainage tiles, then some means of creating a water pathway to the sump pit must be created. If necessary, remove the concrete floor along the inside perimeter of the foundation. Dig a trench to the level of the bottom of the footings leading back to the sump pit. Install a drain pipe complete with crushed stone and filter cloth. Pour a new concrete floor patch over the trench. (A good source of information for foundation options is the CMHC publication *Investigating, Diagnosing and Treating Your Damp Basement*)

2. Seal any snap-tie holes, wall cracks or floor cracks from the inside using a suitable epoxy according to the manufacturer's recommendations.

3. Insulate the foundation on the exterior from the top of the concrete wall to at least 2 feet below finished grade with extruded polystyrene complete with a protective foundation coating and a metal drip cap. An added improvement would be to install a 2 foot wide skirt of extruded polystyrene laid horizontally (on a slight outward slope) at the bottom of the wall insulation. This, however, requires a slightly wider trench. (See higher cost #1 and #2.)

4. When backfilling against the insulation, raise the finished grade enough to provide a slope away from the foundation. This may require installation of window wells. Window wells must be set in free-draining material, preferably linked to the perimeter drainage at the base of the foundation. Ensuring drainage from window wells will be difficult in these conditions. Avoid raising the grade so much as to require deep backfill around the window wells. They may fill up with water causing leakage through the windows.

5. Install insulation and a sealed air/vapour barrier in the joist spaces along the inside face of the rim joist, from the underside of the floor sheathing to the top of the foundation wall. Alternatively, when insulating the foundation on the exterior,

remove the exterior finish up to the top of the floor framing and insulate that area in the same manner that the foundation wall is being insulated.

*Higher Cost Foundation Options*

1. Excavate and waterproof the exterior of the foundation walls. Install full height free-draining exterior insulation. Install perimeter drainage connected to the sump pit. Install a waterproofing membrane over the present floor and pour a new concrete topping slab. (Note: this does not completely resolve the connection at the floor/wall interface.)

Or

2. Either on the present lot or on another drier location, do the following:

- Build a new 4 foot high poured concrete crawlspace foundation with footings at, or close to, the existing grade. The depth of the footings depends on the flood protection required versus the cost of backfill.
- Dampproof the exterior of the foundation walls.
- Install full height extruded polystyrene exterior insulation complete with a 2 foot wide horizontal extruded polystyrene layer above the footings and perimeter drainage.
- Install perimeter drainage, an under floor granular drainage layer and floor drain with backwater valve, all connected to a sealed sump pit.
- Install underslab extruded polystrene insulation complete with a sealed 6mil poly air/vapour/moisture barrier.
- Pour a minimum 3 inch floor slab.
- Caulk all wall/floor junctions or contraction joints with urethane caulking.
- Move the house onto the new foundation.
- Provide a sloping grade around the foundation by backfilling with free draining granular material (if it is available at a reasonable price - at worst re-grade what is available on-site)
- Use the existing stair well, as space permits, for a laundry/utility/water heater area with an access hatch to the crawlspace.
- Install a horizontal electric furnace and heat recovery ventilation system in the crawlspace.

*Note*: it would be possible to use the existing foundation for this purpose if the house was moved off of it while it was filled with granular material and made into a crawlspace as above. However, the disruption and costs might be impractical.

Also: the mold must be eradicated from the house, furnishings and possessions. Otherwise it will just travel to the new foundation.

**Above Grade Building Envelope Recommendations**

1. Repair roofs. Replace any missing shingles. Ensure that all gable end or soffit vents are screened.

2. Repair exterior finish. Ensure that there are drip caps over windows and doors, as required. Caulk around windows and doors. Repair any deteriorated stucco or siding. Re-attach buckled sidings. Patch concrete at basement window sills.

3. Replace any broken window panes or thermal units with broken seals. Windows that are structurally sound and operate smoothly do not require replacement due to mold. Most mold along window edges can be cleaned. Replacement windows, if required, should be a minimum of double glazed thermal units with insulating edge spacers and effective seals. Ensure that all window installations are secure,square, plumb, level, operating properly, air sealed with polyurethane foam, caulked and properly capped. Poor or unfinished installation can cause cold spots resulting in condensation and mold growth.

4. Tighten up the building envelope: replace drafty or loose weatherstripping on

doors,windows or attic hatches; seal holes around penetrations.

### Ventilation and Mechanical Systems

*Lower Cost Ventilation Options*

- Ensure that existing bathroom ceiling exhaust fans are vented directly to the outside with sheet metal duct complete with sealed joints. Seal the joints with aluminum duct tape. Insulate over the duct and slope the duct to a clear hood termination on the underside of the soffit or on the exterior wall. Do not vent into the attic or soffit.

- Alternatively, upgrade the existing fan to a unit that has a centrifugal blower, a sound rating of 2.5 sones or less, and is capable of meeting the principal exhaust fan requirements of the *1995 National Building Code*. This type of fan will provide more airflow. A quiet fan is also more likely to be used for longer periods of time.

- Retrofit or upgrade existing kitchen range hoods to units which exhaust directly outside. All units should have speed controls and short runs of rigid sheet metal duct with joints with aluminum duct tape. Any ducts passing through unheated space must be insulated. Ducts must either be accessible for cleaning or provided with a grease filter.

- Re-locate existing fresh air intake ducts to sources of cleaner air away from driveways or other exhaust hoods, as necessary. Install rigid sheet metal duct complete with insulation and sealed air/vapour barriers to reduce condensation. Maintain intake screens periodically to ensure that they are clear.

- Improved ventilation will not reduce humidity in the house if the weather outside is warmer and more humid than it is inside. Cool basement surfaces are particularly prone to condensation when warm, humid air is introduced in summer. Dehumidification is essential. Install a portable dehumidifier and empty it as required. Clean and disinfect it periodically.

- Replace any dryer flex duct with aluminum duct in short, direct runs. Seal all joints with aluminum duct tape.

- Ensure that heating supply ducts are connected or, if necessary, installed in every room.

- All of the houses have central, or shared, return air registers. If an individual room door is closed, the back pressure developed may prevent that room from receiving heat. Undercut any room doors necessary by at least one inch or provide louvers through the doors to ensure good return air flow to the central returns. Retrofit furnace switches as required to run furnace fans as continuously as possible. This may create cool drafts in winter and is not energy efficient. A two-speed fan is recommended.

*Higher Cost Ventilation Options*

Using bathroom fans, range hoods and fresh air intakes to the return trunk of the furnace as a ventilation strategy has two major problems. First, it is expensive and inefficient to exhaust heated air and bring in cold air which must then be heated. Second, there is no balance between supply and exhaust.

When the exhaust fans are operating, cold air can be drawn through every air leakage point in the building, causing uncomfortable drafts and providing air to breathe that was filtered through building envelope components at random.

When the exhaust fans are off and the furnace fan is on, cold air is drawn into the house and must be heated. Now more drafts are likely to blow warm moisture-laden air outwards. Condensation can occur as that heated air cools on its way out. Condensation in building envelope cavities, under the right conditions, may lead to more mold growth.

A sealed building envelope and balanced heat recovery ventilation system are much better for general indoor air quality, humidity control and energy efficiency.

- Install a balanced heat recovery ventilation system integrated with the existing forced air heating system. This type of system renders individual bathroom fans and fresh air intakes unnecessary. Install a two-speed fan in the furnace and run the fan on continuous low speed for air circulation and on high speed when heat is required.

## Part 3: Recommendations for Homeowners

Not all indoor air quality problems are mold problems. The following list of recommendations can help to improve the indoor air quality in any house.

- Ban smoking in the house. Smoking anywhere in the house will result in second-hand smoke being distributed throughout the house by the furnace fan and heating ducts. The effects of environmental tobacco smoke are well documented. The combination of mold and tobacco smoke is worse. Ban smoking completely.

- Watch for any signs of mold. Look in any place that might have been damp: the edges of windows; around any kitchen or bathroom fixtures (including the ceiling exhaust fan); around water pumps or pressure tanks; in floor drains or sump pits; under stored items in the basement; in any known water leakage areas; behind any unsealed rim joist insulation; at the back of closets. Dab any suspicious stain with a spot of household bleach. If the colour is largely removed, the stain is likely organic and probably mold. Apply undiluted household chlorine bleach to the moldy area so that it stays wet for at least fifteen minutes. Use a combination of one part bleach, four parts water and a bit of non-ammonia dishwashing detergent to clean the surrounding area. Only do this under well-ventilated conditions. Chlorine bleach is harmful to lungs. Follow the guidelines in the CMHC booklet *Clean-up Procedures for Mold in Houses.*

- Discard any stored furnishings, boxes, clothing, magazines, books, etc. which are not needed. These are all 'sinks' for odours and breeding places for molds, particularly if stored in the basement where the humidity level is likely to be higher near the cool floor.

- Collect and remove all chemicals, paints and aerosols in the house. Use traps, not poison, for mouse problems.

- Use the bathroom fan and range hood frequently, provided that they exhaust outside. This will help to reduce humidity.

- If possible, run the furnace fan continuously when it doesn't create a cold draft problem. This will help to circulate the air in the house

- Reduce the use of harsh chemicals for cleaning. Substitutes are baking soda in water or vinegar in water. For greasy surfaces, use dishwashing detergent but rinse the surfaces off later. Eliminate the use of fabric softeners. Use bleach only for mold clean-up. Room deodorizers add pollutants to the air. They do not remove odours; they mask them. Volatile organic compounds are emitted into the air from these cleaners and can be the cause of headaches or discomfort, especially in persons who may have become sensitized due to exposure to mold.

## Part 4: New Construction

### Which houses are at greater risk of mold problems?

1. Any house that has suffered flooding or seepage problems in the past might suffer flooding or seepage problems in the future lifetime of that building, despite improvements in foundation waterproofing or drainage.

2. The houses at greater risk of flooding or seepage, resulting in mold growth, are those:
- outside the dike;
- inside the dike on wetter sites;
- inside the dike without community water and sewer services;
- with deeper foundations

3. The houses at greater risk of excessive humidity and condensation, resulting in mold growth, are those with:
- high occupancy
- any water leakage
- ineffective bathroom exhaust ventilation
- recirculating range hoods
- ineffective or non-existent fresh air supply
- uncontrolled air leakage
- cold interior surfaces

### THE STYLE OF CONSTRUCTION MUST CHANGE!

### New Construction Recommendations

*Note:* all construction recommendations must be reviewed by a consulting engineer familiar with local conditions and requirements.

The most important aspect of ensuring that houses appropriate for this community actually get built is development of detailed specifications that both contractors and inspectors can follow. Contractors build to meet the standard that is required. Inspectors can only inspect to a clearly defined standard. Vague criteria like 'water resistant', 'well ventilated' or 'improved indoor air quality' are worthless.

Both contractors and inspectors need detailed specifications.

Most of the houses in this community are already built in a similar style. For the near future, new construction could all be developed from one set of model specifications, which would incorporate details that would not only meet the National Building Code, but would also meet the existing R-2000 standard and be suitable for the specific needs of this community in this location.

Variations in exterior appearance can be achieved by reversing plan layouts; using hip roofs or gable roofs on adjacent houses; and changing siding, roofing and exterior trim colours. Changes in interior appearance can also be achieved with different wall, floor and trim colours, as well as different cabinet and door styles.

But, the basic house system remains the same. Different designs incorporating refinements in the house system could be developed as time and financing permit.

As much as possible, all new construction should be inside the dike on known drier sites with community sewer and water services available.

New homes should be well-insulated slab-on-grade bungalows, raised above the existing high water table, and complete with insulated floors, main floor utility rooms and heat recovery ventilation. Designs should be evaluated and revised to provide low pollution, cost-effective building envelopes, heating and ventilating systems and finishes. Eliminate the source of pollutants by using materials with the lowest possible emissions. In short, build modest flood resistant R-2000 houses. The savings and health benefits realized from building to a flood resistant, higher quality standard will quickly offset any increased construction costs.

Similar construction has been accomplished in many places including the office in which this report is being written. As well, an Ontario First Nations managed building organization, belonging to the Mohawks of the Bay of Quinte, has been recognized by the Ontario Home Builders' Association for the energy efficient R-2000 rental homes that they have been building, at minimal extra cost, for their community.

Develop detailed specifications and build one house as an experiment.

The following general specifications are a brief overview of the type of house construction recommended.

### Foundations

1. The depth of excavation depends on the flood protection required versus the cost of free draining granular material for backfill. Ideally, scrape the location of the new construction only deep enough to remove surface organic material. If necessary install a layer of free draining, well compacted, material before pouring footings.

2. Pour footings as required.

3. Pour four foot high concrete foundation walls. Investigate the cost of insulated forming systems. (Several different proprietary systems are available)

4. Dampproof the exterior of the foundation walls.

5. Install full height extruded polystyrene insulation on the outside of the foundation complete with a two foot wide skirt over the footings for increased frost protection. Frost protection is provided by the construction techniques as well as surrounding backfill, not just by surrounding backfill alone. Greater insulation value can be provided for the top two feet of the foundation by doubling up the insulation layer, if insulated forms are not used.

6. Backfill both sides of the foundation walls. On the inside, spread the material with a

stone slinger and compact every six inches according to good construction practice. On the outside, provide a sloping grade around the foundation. This is probably the most expensive part of the foundation, depending on the availability of free draining material.

7. Install all below floor plumbing required, including a utility room floor drain with backwater valve.

8. Install a sealed moisture barrier and extruded polystyrene under-slab insulation

9. Pour a concrete slab floor at the same level as the top of the foundation walls.

### Main Floor Construction

1. There are many options, but 2x6 wall framing with insulating exterior sheathing is probably the most cost effective. Use 'optimal engineering' framing techniques which minimize unnecessary wood components and maximize insulation. Roof construction will be close to standard. Appropriate construction manuals such as the Canadian Home Builders' Association *Builders' Manual* are available.

2. Use the rain-screen wall technique for the exterior wall finish.

### Heating and Ventilating

1. Install a forced air heating system and heat recovery ventilation system. The design of the existing bungalows would lend itself very easily to provision of a dropped ceiling in the hall which could be used for supply and return trunks. It is also possible to run supply trunks along the perimeter of the building at ceiling level, concealed by drywall bulkheads. Providing supply of warm air at floor level below windows is unnecessary in a tight, well-insulated building with good windows.

2. The heating and ventilating systems can either be integrated or separate, fully ducted systems. There are advantages and disadvantages to each one.

### Interior Finish

1. Install insulation in the walls and ceiling according to the design specifications and complete it with a sealed air/vapour barrier.

2. Install low pollution finishes: painted drywall using paint with low emissions of volatile organic compounds (VOC's); composition vinyl tile floors; no carpets; water based, low VOC,finishes on doors and trim; cabinet materials chosen for low emissions, such as locally available hardwood, or laminated softwood plywood; etc. Details are available in several CMHC publications including *Building Materials for the Environmentally Hypersensitive.*

## Part 5: Organization of Resources

1. Although there is tremendous effort by a dedicated group of concerned stakeholders in this problem, to an outsider there does not seem to be a clear chain of authority. Clear authority and criteria for house inspection, remediation and renovation must be established to break the cycle of recurring mold contamination.

2. Make use of available programs and resources. For example:

- Select and modify a housing inspection checklist so that it is suitable for this community. Water leakage points, in particular, must be found and fixed as quickly as possible. Standard checklists are available from CMHC. A clear checklist will be easy to use by inspectors with minimal training or even by interested home occupants.

- CMHC's "Let's Clear the Air" one day seminar along with the one day Residential IAQ Field Training Session are recommended for all involved health and housing professionals, to enable them to better understand the identification and underlying causes of indoor air quality problems.

- Natural Resources Canada has recently developed the Energuide Program for Houses. This is an energy efficiency program but offers benefits for indoor air quality in the use of design evaluations for cost-effective selection of building envelope components (which could help to reduce cold spots prone to condensation) and airtightness testing which can locate air leakage points in need of repair (thus giving more control over indoor air). There is enough renovation required in this community to train and equip a community member to do this work.

- The Heating, Refrigerating and Air Conditioning Institute of Canada offers training in residential mechanical ventilation and a ventilation service and maintenance guide. Use mechanical contractors who are qualified and up-to-date.

- As one way of identifying certified windows, contractors and installation, consider using the new "Window Wise" program developed by the Siding and Window Dealers Association of Canada (SAWDAC).

# CONCLUSIONS

The following conclusions can be drawn from this research report:

1. The house investigations performed for this report cannot confirm that mold remediation previously undertaken and currently being implemented, is effective. In one house undergoing renovation at the time of the site investigation, mold on the windows, subfloor, poly air/vapour barrier, bathroom ceiling exhaust fan and ceiling insulation was clearly not eliminated. While new drywall, paint and tile floors have made some of the investigated houses look clean, the extent of the visible mold in the only house where the walls were uncovered leads to the suspicion of similar mold covered up in the other renovated houses.

2. Except for some improvements made to sump pits and floor drains, most of the other recent renovations are best described as cosmetic and do nothing to resolve the underlying causes of recurring mold problems. Waterproofing, drainage and ventilation have been ignored.

3. The recurring mold problems cannot be attributed solely to a single flooding incident. Some of the moisture problems are related to the flood of 1997 but many of the problems are chronic, stemming from the drainage limitations of the community site and from construction techniques which are unsuitable for high occupancy homes on a wet site, in a cold climate.

4. Poor site drainage resulting in seepage into basements is the largest single contributing factor to the mold problems. Unless water entry is stopped, mold problems will continue.

5. Original building construction techniques have made the buildings, particularly the foundations, more susceptible to moisture and mold problems. Insulating and finishing basements on the interior of leaky foundation walls has created hidden growth sites for mold. Poor detailing of above grade building envelopes and insufficient drainage provisions have exacerbated problems.

6. Although the focus of this report is development of recommendations for improved indoor air quality, opportunities for energy efficiency should not be overlooked. Improved building envelopes and mechanical systems will result not only in better indoor air quality but also in lower energy costs. In a community which is based almost exclusively on electricity, an expensive fuel source, the annual energy savings from carefully planned renovations and new construction can quickly help to pay back the capital cost expenditure.

7. Renovation of foundations should include exterior insulation and improved drainage. New homes, in such a poorly drained location, should be built without basements. Development of model new home specifications which meet the National Building Code, the R-2000 standard, and the requirements of the community and location is recommended.

8. Sewage back-up is also a serious sanitation concern.

9. The inadequate mechanical ventilation has contributed to the mold problems. Bathroom ceiling exhaust fans not ducted directly outside, recirculating range hoods, non-existent or poorly located fresh air supplies and unbalanced forced air circulation systems, all of which operate intermittently, cannot provide adequate ventilation in houses with high occupancy rates located in a cold climate. Balanced heat recovery ventilation is recommended.

10. Inadequate building maintenance is also a contributing factor. A simple house inspection and maintenance protocol must be created. Water entry and subsequent mold growth is not always due to major foundation deficiencies. Missing shingles and poor eavestrough drainage are also responsible for water leaks and resulting problems.

11. Other pollutants, particularly environmental tobacco smoke, are contributing to poor indoor air quality. Occupants must be encouraged to accept more responsibility for the air quality in their homes.

12. Effective mold clean-up alone, although a necessary start, is not enough. Remediation of the underlying causes of the mold growth is required.

13. Clear designation of authority for standards, actual construction and payment of contractors must be delegated to a single entity in order to eliminate any confusion over responsibilities.

14. Unless there is a dramatic shift in focus, the current cycle of mold contamination, remediation and renovation should be expected to continue repeatedly, with no end in sight.

15. There is a large financial and social cost to pay for the mold contamination, remediation and renovation cycle. The money that has been spent in the past year should be considered an indication of the annual budget required unless the remediation approach changes. The hardships endured by families facing repeated evacuations is incalculable.

16. The costs of the recent and ongoing mold remediation and renovation can also be considered to be an opportunity. Compared to the financial and social costs currently being experienced, a new approach which solves, rather than covers up, problems and which also provides more durable, energy efficient housing, could be far less expensive and certainly far less stressful for the families involved, than repeated evacuation, mold remediation and renovation of houses which were not originally built to an appropriate standard for such a difficult location.

# BIBLIOGRAPHY


Canadian Home Builders' Association. *CHBA Builders' Manual.* Ottawa, Ontario, 1994.

Canada Mortgage and Housing Corporation. *Building Materials for the Environmentally Hypersensitive.* Ottawa, Ontario, 1995.

Canada Mortgage and Housing Corporation. *Clean-up Procedures for Mold in Houses.* Ottawa, Ontario, 1993.

Canada Mortgage and Housing Corporation. *Cleaning Up Your House After a Flood.* Ottawa, Ontario, 1994.

Canada Mortgage and Housing Corporation. *Guide to Mechanical Equipment for Healthy Indoor Environments.* Ottawa, Ontario, draft.

Canada Mortgage and Housing Corporation. *Investigating, Diagnosing and Treating Your Damp Basement.* Ottawa, Ontario, 1992.

Canada Mortgage and Housing Corporation. *Molds in Finished Basements.* Ottawa, Ontario.

Canada Mortgage and Housing Corporation. *Toxic Mold Clean-up Procedures.* Ottawa, Ontario, draft.

Canadian Wood Council. *Permanent Wood Foundations.* Ottawa, Ontario, 1992.

Environmental Health Directorate. *Fungal Contamination in Public Buildings: A Guide to Recognition and Management.* Health Canada. Ottawa, Ontario, 1995.

# APPENDICES

1. Summary of Mold Meetings Minutes

2. Health and Welfare Canada list dated February 26, 1998

3. Remediation Chart (undated)

4. G. Woodward Restoration Services Ltd. Breakdown of tasks that may have been performed...

A summary of minutes from mold meetings
Compiled by Marj Heinrichs from minutes received from Cam King, MANFF, Helen Powley, Red Cross, and Marj Heinrichs, Evacuation Coordinator.

January 14
EMO has inspected 30 homes for mold, and suggests an evacuation, especially for those with health problems (even before inspection process completed.)
Medical services is to determine who is to be evacuated and when.
EMO wants a proper cleanup – strip to studs, wash and disinfect, dry, correct existing problems before rebuilding.
Professionals to do cleaning.
EMO will identify moisture problems casing mold.
EMO will pay flood related moisture problems.
Band to pay pre-existing moisture problems, i.e. gutters, eavestroughs, grade, etc.
EMO will cover furniture/clothing according to guidelines for flood victims.
Ongoing costs for evacuees, including evacuation costs, hydro, rent, etc, also covered by ESS.
Cheque for ESS will be written when a list of evacuees is given to EMO by the band.
EMO will reimburse for security.
EMO wants long-term solutions for drainage and ongoing moisture problems.
A committee is formed including representation from EMO, INAC, Trauma Team, Medical Services, Red Cross and Band representatives.

January 19
Testing is ongoing.
EMO/Band invite Grady Woodward of G. Woodward Restoration Service to attend meeting. Describes cleaning process. He will also inspect and identify moisture problems.
EMO will pay $7.50 per load of laundry. (ESS) guidelines.
Cost of cleaning homes will be approximately $9.00 sq. ft. (strip, clean, dry)
Gary Roberts to be responsible for all aspects of cleaning.
12 band members hired to provide 24 hour security.
James Nelson to be responsible for information re: repairs, determining pre-existing versus flood, and evacuation/return logistics.
Mike (INAC) to liaise with Natural Resources re nine houses outside dyke.

INAC wants information re costs in order to evaluate funding.
Dr. Clearsky (Canada Health) has issued a directive that all those with asthma or health risks must be evacuated until their homes have been checked and approved for re-entry.
MEMO has no problem with the band using money they are reimbursed for bringing the basements back to "pre-flood" for landscaping and mitigation if INAC is in favor. However, they will not consider another claim for finishing the walls.

January 21, letter to Chief and Council from Mike Radwanski
Review by INAC indicates that the emergency social services costs and the cleaning and repair costs of houses affected by mold are to be treated as flood-related costs and are to be submitted to MEMO for reimbursement.
...There is to be no segregation of costs to deal with only the houses that had repair claims for flooding.

January 23 – Cam's meeting with MEMO
MEMO feels a cheque can be issued after receiving a letter from INAC to Roseau's Chief and Council.

January 26
204 houses checked to date. MEMO indicates they will also check the school, office buildings and garages.
MEMO will provide Roseau with reports on each house.
Grady Woodward reported on "building failures" and MEMO indicated they would evaluate for dollar allowances.
MSB wants to swab houses after cleaning is done to assure health safety.

Cam's phone conversation with Mike
EPC and MEMO to meet Jan. 27 to discuss the funding issues.
MEMO has identified 110 housing claims for the flooding and will consider compensation for those. The remaining to be INAC's responsibility.
MEMO will not advance money. This is contrary to our understanding from previous meetings.
Band will pay mileage to evacuees for getting to work and/or school on the reserve. Vehicle rental must be paid out of mileage.

January 30
Grady Woodward reports 25 basements stripped (only those with stachybotrus to be gutted. Says most foundations are structurally sound and won't require major work.
EMO reports some trailer crawlspaces could not be tested because ground frozen.
Reported that a complete basement stripping occurs for all houses regardless of whether stachybotrus is present or just other molds. Concern re: Provincial versus Federal requirements. (Two different labs are being used to analyze results, causing more delays and confusion in reading results).
Need a letter from Dr. Clearsky stating all houses require complete cleaning.
Marvin (Mb. Health) says new protocol says to clean only mold spots, not whole house. Band wants to keep up current practice to be safe and want letter from Dr. Clearsky to this affect.
Water Resources will not consider floodproofing within dyke. Not even enough money to floodproof Provincial requests.
Advance has come from INAC - $300,000 initially with further advances based on projections or budget. Band will use the money to pay outstanding bills associated with the ESS component, and then submit bills to MEMO for payment. MEMO will reimburse the Band as per guidelines and the Band will reimburse INAC and/or negotiate the differences from the advances.
Reserve wants breakdown on who pays administration costs. Overtime for existing staff will be considered by INAC.
Turnaround time for bills reimbursed from EMO are two to three weeks.
INAC said they will look at shortfall (difference between what's billed to EMO and what's eligible/acceptable by guidelines) and will "probably not nickel and dime it." Need this in writing.
Need to get bills in to EMO ASAP.
Whatever not looked at by EMO will be looked at by INAC.
Concern with evacuation due to existing social problems and damages in hotels – who pays? Band.
Request to Red Cross to help with evacuation problems, especially with children.

February 4
Discovered that not all houses were swabbed by EMO. 87 were not swabbed. People have been evacuated from some of those homes because of medical problems and Medical Services was never told by MEMO that it was all right for them to go back in. 15 evacuated houses with no noted mold problems will be cleaned anyway (per Medical Services).

Band receiving results from labs on homes not associated with the Reserve.
Test results from homes coming in on different days – one day results are clear, next day more results say Stachy.
Decided to move people in before 'after cleaning' result comes in, because a protective barrier remains 30 days after cleaning. MSB said random spot checks will be done 30 – 60 days after cleaning is completed.
EMO now says administrative buildings are not their responsibility, but the Feds.
Concern that EMO has not given reports on houses to the Band.
Salvation Army providing furniture for five rental houses.
School was closed for one day due to flu like symptoms. Ducting will be cleaned and sanitized and school will be closed for one more day.
Grady keeping list of all materials and goods destroyed in the cleanup.

February 6, letter to MEMO from Chief and Council
Regarding lack of well-documented information which is needed for evacuation, clean up and reentry. As well, public buildings were not tested by MEMO as was expected. Only 80 of 204 expected reports were received.

February 4, letter to MEMO from Cam King
Requesting a detailed, complete listing of all buildings inspected by MEMO staff and expressing concern about a lack of results forwarded to the Band.

February 12
Meeting at the school, lengthy discussion on the stresses of the children and adults.
10 houses with stachybotrus were cleaned and retested and found to still have unacceptably high stachy counts. Federal lab suggests sealing basements with microbe inhibiting paint. Grady will check into this further.
Grady reports of 114 houses he is aware of, 40 need basement stripping.
Decision to give everyone a $75 food voucher to cover cost of open food thrown out by cleaners, i.e. crackers, cereal, etc. Products used are environmentally safe. This is a precaution.
There is a need for a drop-in to be set up at Roseau.
Several houses have been identified to need major renovation work. Grady is taking care of minor, but immediate problems. Starting to apply sealing product to basements. Jim wants problems taken care of before sealing basements. The Spring thaw will likely reveal more existing problems. This will stop whatever is in the concrete from coming out, but if flooded again, will have same problems. Grady concerned about the combination of a lack

of air movement and humidity causing problems. Air exchangers ranging in price from $1,500 to $3,000. (estimates from John Roots.) This still does not take care of high water table or flooding.
Problem with basements which were renovated last year. Vapor barrier was put on both sides of insulation rather than only one, double poly was put in behind concrete, probably to prevent water from coming in if there was flooding. However, it allows no breathing so now puddles of water are appearing on the floor.
Marvin reports EMO is indicating that out of 80 homes, only three are flood related problems.
Mike says EMO is only going by actual claims for damage. If there is no claim it doesn't mean it's not flood related, it just is not claimed for.
EMO is saying that if no claim was put in prior to the testing, then it is not considered flood related. INAC can't split hairs like that.
Nobody is happy with EMO reports.
Mike said flood related or not, INAC will provide advance to Band re: those houses deemed not flood related and not reimbursed by EMO. Band will pay Grady out of Band money, keeping invoices separate to take up with EMO later.
Bernie Henry states band needs to minimize chances of this mold happening again by taking care of problems.
Concern again about articles missing from houses. Grady will provide a list and will deal with the RCMP when it appears theft was involved.

February 26
Discussion on school. Suspect a landscaping problem (John Roots). Will be checked out by John. Also need to check electric fan control.
Gary assembling crews to pump out basements and ditches. A problem with storm water draining into sanitary water supply. Need to increase pump outage to keep water out as much as possible until repairs are finished in fall.
James concerned about people living in homes which have not been put back together – i.e. flooring, basement bedrooms..
CMHC brings up the RRAP money. Allows for capital funding, but can reapply to extra funding for capital expenses. There is no emergency repair money however.
Stachybotrus becoming an increasing problem in the Rapids.
Need to use DOTC and INAC agreement for technical expertise to inspect. Possibly Simon Prince.
Marvin says need to redo basements , especially those with double vapor barrier. Needs a list.

Mike says INAC will look at hotel damages/loss/theft issues. Individuals who damaged hotel rooms are responsible for those charges. Theft should go to the RCMP.
Mike reports a session held Feb. 25 between EMO and INAC and EPC as to process and as to who/what will be covered under EPC guidelines for flood related damage. EMO and INAC are both bound by criteria set out by EPC. If house damaged by flood, funding is clear. Only moldy homes cleaned will have cleaning funded under DFA agreement. Balance of homes with mold will be funded by INAC (Cleaning only). All claims are to be sent to EMO. They will sort out and let band and INAC know what's not reimbursable. INAC is advancing funding for all, so existing programs on reserve are not saddled with these costs. Once mold is identified, strip out/clean/repair of basements will be done back to pre-existing (before flood). INAC will review landscaping, grading, etc. but is not committing. First answer would be to use capital housing renovation program. However, this is open to review.
Mike says discussions with EMO and EPC are ongoing re restoring to previous condition. Maybe funds can be used for remediation/preventative measures rather than refinishing basements with drywall, etc.
Will CMHC cover sots of basements? Mike says it depends on houses with families needing livable spaces right now. However, preventative measures have to be taken to ensure this doesn't happen again. Discussion is ongoing between Band and INAC re: cost sharing between Band's capital and INAC's capital.
Still no decision made between INAC and MSB re MSB helping with funding.
If evacuation costs not picked up by EMO, INAC probably will. At this point, EMO has 89 homes on their list, INAC has 116.
INAC will react week by week with necessary funding.

March 5
Two houses vandalized and will need cleaning up before mold cleaning can happen.
Work has begun at Roseau Rapids.
Mushrooms growing on the floor of C187.
Eleven houses were flooded (again) and problems are being identified. Will be pumped out, but not recleaned by Grady.
INAC clear: these re-flooded houses can not claim for recleaning and damages. Vandalized houses cannot claim for repairs/replacement. No claims allowed for rashes after coming home (i.e. beds).

Gary Roberts identifies 116 homes with flood damage. MEMO has identified 114.
Grady indicated major problems he has identified include: foundation faults, wind leakage, internal plumbing problems and landscaping. Other potential outstanding problems should be identified during the spring thaw.
Repair/replacement of cisterns should be done under DFA.
Government buildings still not checked.

March 16
A need for a clear statement on who pays for what regarding the mold issue is identified. Many issues coming to light during inspections and cleaning.
MEMO clear they will be responsible for those houses identified as having been flood related. 114, or possibly up to 120 of 204 could qualify, but none from the Rapids are included. (Although there is Stachy present there).
The Band understands the federal government will pick up anything the Province cannot pay. This is understood to be new money and not coming from their capital dollars. Lorne Cochrane said to do "whatever needs to be done and we will deal with the Province about payment."
CMHC has indicated they will help out vis a vis the CMHC homes. They will need a budget for the extras required (air exchange systems and structural repairs, etc.)
Who pays for what needs to be put in writing.
Still nothing on 9 houses north of the dike.
Still no money from MEMO for initial billings. It is assumed this is due to INAC and MEMO not having come to final agreement on the amount INAC will repay MEMO.
Need for a meeting between INAC, MEMO, CMHC, Medical Services, Natural Resources and the Band.
Band houses will be eligible for RRAP grants of $12,000. Perhaps INAC will reimburse these loans.
G16, B187, C208 and E237 identified as problems.
Simon to be hired to identify what needs to be done in each unit.

March 20; letter to Chief and Council from INAC
89 of 114 flood damaged homes have mold. Evacuation, stripping, treatment, cleaning and reconstruction to be billed to MEMO. Work on balance of homes with mold will be paid by INAC. School to be paid by INAC. Grady Woodward to provide billings to EMO and INAC. INAC will review, but not commit additional renovation costs (i.e. landscaping, grading, heat recovery ventilators, down spout and sump pump extensions).

March 23; letter to Marj Heinrichs and James Nelson from Cam King
Bills are to be split. Only those bills related to those houses inspected by MEMO are to be sent to MEO the remainders are to be billed directly to INAC. Need separate billings for every household.

Health and Welfare Canada | Santé et Bien-être social Canada

Marge Henries

Your file / Votre référence
Feb 26/98
Our file / Notre référence

Stachey:

Laurence Antoine ✓
Lorraine R. Thomas ✓
Ley Greene ✓
Grace Smith ✓
Lisa Roberts
Marie Henry ✓
Josie L. Nelson ✓
Marcel Lennie ✓
Charles Nelson ✓
Bernice Antoine ✓
Marlene D. Henry ✓
Keith Henry ✓
Annie Henry ✓
Priscilla Chachey ✓
Mary Roberts ✓
Richard Johnson ✓

Mouldy

Gladys Nelson
Helen Lennie
Christie Atkinson
Eunice Lennie
Evelyn Patrick
Eric Atkinson
Caron Thomas
Leonard Nelson
Gerald Tait
Brian Laroque
Lorraine Martin
Francis Littlejohn
Kenneth Littlejohn
Gale Littlejohn
Laurence Tait
Gloria Littlejohn
Marcy Nelson
Richard Hayden
Ann Thomas

Canada

ID:

FEB 26'98 15:14 No.006 P.01

Stacky:

Mouldy

Lucy Nelson
Ralph Antoine
Sharon Thomas
Linda Larocque
Aldene Thomas
Mitch Larocque
Josie M. Nelson
Abigail Lakotas
Brian Thomas (Steve Jessie)
Lyonne Nelson
Marjorie Nelson
Pearl Henry
Larry Atkinson
John S. Nelson
Maryjane Atkinson
Alfred Smith

ID: FEB 26'98 15:15 No.006 P.03

Your file / Votre référence

Our file / Notre référence

2626/98

## Stachy

Sandra Hayden ✓
Willie Laroque ✓
Candice Smith ✓
Gina French ✓
Alfred Johnson ✓
Myra Littlejohn ✓
Cheryl Littlejohn ✓
Barbara Atkinson ✓
Kenneth Hayden
Marie Smith ✓
Edward Martin ✓
[redacted] ✓
Rojean Atkinson ✓
Mary Laroque ✓
Edward Hayden ✓
Theresa Leezie ✓
Karen Standish ✓
Gabe Daniels ✓

## Maulay

Bill Paul
Nancy Laroque
Eileen Henry
Daniel Hayden
Larry Patrick
Lydia Alexander
Rose Atkinson
Sharon Roberts
(Daniel) Austin Alexander
Susan Powers
Gonzalo Martinez
Lynn Ballantyne
Wendy Nelson
Leslie Atkinson
Jerry Martin
Cheryl Hayden
Adam French
Belinda Johnson

Canada

FEB.26'98 15:14 No.006 P.02

ID:

56 basement stripped out

ROSEAU.XLS

65 EMU
68 IN AC

NN = NOT NECESSARY

| JOB SITE | STRIP OUT | POWER VAC | POWER WASH | CLEAN UPS | Electrical | Plumbing | Cistern |
|---|---|---|---|---|---|---|---|
| A-1 | X | X | X | X | X | X | |
| A-3 | X | X | X | X | X | X | |
| A-5 | X | X | X | X | X | X | |
| A-7 | NN | X | NN | X | NN | NN | |
| A-20 | NN | X | X | X | X | X | |
| A-22 | NN | X | X | X | X | X | |
| A-23 | NN | X | X | X | X | X | |
| A-26 | | | | | X | X | |
| A-27 | NN | X | X | X | X | X | |
| A-28 | X | X | X | X | X | X | |
| A-32 | X | X | X | X | X | X | |
| A-33 | X | X | X | X | X | X | |
| A-35 | NN | X | NN | X | NN | NN | |
| A-37 | NN | X | X | X | X | X | |
| A-38 | NN | X | NN | | X | X | |
| A-41 | NN | X | X | X | X | X | |
| A-46 | NN | X | X | X | X | X | |
| A-50 | NN | X | X | X | X | X | |
| A-51 | NN | X | X | X | X | X | |
| A-53 | NN | X | X | X | X | X | |
| A-54 | NN | X | X | X | X | NN | |
| A-55 | NN10 | X | X | X | X | X | |
| A-56 | X | X | X | X | X | X | |
| B-50 | NN | X | X | X | X | X | |
| B-57 | NN | X | NN | NN | X | X | |
| B-58 | X | X | X | X | X | X | |
| B-62 | NN | X | X | X | X | X | |
| B-66 | NN | X | X | X | X | X | |
| B-67 | X | X | X | X | X | X | |
| B-68 | X | X | X | X | X | NN | |
| B-73 | NN | X | NN | X | NN | NN | |
| B-74 | NN | X | X | X | X | NN | |
| B-75 | X | X | X | X | X | X | |
| B-78 | NN | X | NN | X | NN | NN | |
| B-79 | X | X | X | X | X | NN | |
| B-82 | X | X | X | X | X | X | |
| B-87 | X | X | X | X | X | NN | |
| B-88 | NN | X | NN | X | X | X | |
| B-89 | NN | X | X | X | X | NN | |
| B-90 | X | X | X | X | NN | X | |
| B-91 | crawlspace | X | NN | X | NN | NN | |
| B-94 | crawlspace | NN | NN | X | NN | NN | |
| B-95 | NN | NN | X | X | X | X | |
| B-96 | NN | X | X | X | X | X | |
| B-97 | X | X | X | X | X | X | |
| B-98 | X | X | X | X | X | NN | |
| B-99 | X | X | X | X | X | X | |
| B-108 | NN | X | NN | X | NN | NN | X |
| B-109 | X | X | X | X | X | X | X |
| B-110 | NN | X | X | X | NN | X | X |
| B-111 | | | | | | X | X |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| B-116 | X | X | X | X | X | X | X |
| B-120 | X | X | X | X | X | X | |
| B-121 | NN | X | X | X | X | X | X |
| B-127 | | | | | | | X |
| B-134 | X | X | X | X | X | X | X |
| B-145 | NN | X | X | X | X | X | X |
| B-146 | NN | NN | NN | NN | X | X | X |
| B-148 | NN | X | NN | X | NN | NN | X |
| B-149 | X | X | X | X | X | X | X |
| B-150 | | | | | | | X |
| B-151 | | | | | | | X |
| B-152 | | | | | | | X |
| B-158 | X | X | X | NN | X | X | X |
| B-187 | NN | NN | NN | Pack out | X | NN | |
| C-172 | NN | X | NN | NN | X | NN | X |
| C-184 | NN | X | X | X | X | X | |
| C-189 | NN | X | X | X | X | X | |
| C-198 | NN | X | X | X | X | X | |
| C-199 | X | X | X | X | X | NN | |
| C-203 | X | X | X | X | X | X | |
| C-204 | X | X | X | X | X | X | |
| C-206 | NN | X | NN | X | NN | X | |
| C-207 | X | X | X | X | X | X | |
| C-208 | NN | X | NN | NN | X | X | |
| C-210 | X | X | X | X | X | NN | |
| C-211 | X | X | X | X | X | X | |
| C-213 | X | X | X | X | X | X | |
| C-214 | NN | X | X | X | X | X | |
| C-215 | X | X | X | X | X | X | |
| C-216 | X | X | X | X | X | X | |
| C-218 | X | X | X | X | X | X | |
| C-220 | X | X | X | X | X | X | |
| C-221 | NN | X | X | NN | X | X | |
| C-222 | X | X | X | X | X | X | |
| C-223 | NN | X | X | X | X | X | |
| C-225 | X | X | X | X | X | X | |
| C-226 | NN | X | X | X | X | NN | |
| C-227 | X | X | X | X | X | X | |
| C-229 | X | X | X | X | X | X | |
| C-231 | NN | X | NN | X | X | X | |
| C-232 | X | X | X | X | X | X | |
| D-1 | X | X | X | X | X | X | X |
| D-46 | NN | X | X | NN | NN | X | X |
| D-47 | | | | | | | X |
| D-48 | NN | X | X | X | X | X | |
| D-49 | X | X | X | X | X | X | X |
| D-50 | X | X | X | X | X | X | X |
| D-63 | X | X | X | X | X | X | X |
| D-64 | NN | X | NN | NN | NN | NN | X |
| D-65 | NN | X | NN | X | NN | X | X |
| E-231 | | | | | | | X |
| E-234 | | | | | | | X |
| E-236 | X | X | X | X | X | X | X |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| E-237 | X | NN | NN | NN | NN | NN | |
| E-238A | X | X | X | X | X | X | X |
| E-238B | NN | X | X | X | X | NN | X |
| F-9 | NN | NN | NN | X | NN | NN | X |
| F-10 | X | NN | X | X | X | X | |
| G-15 | X | NN | X | X | X | X | |
| G-15B | X | X | crawlspace | X | NN | X | |
| G-16 | X | X | X | Pack out | X | X | |
| G-18 | X | NN | X | X | X | NN | |
| G-19 | | | | | | | X → no folder. |
| G-20 | X | | | | | | X |
| G-21 | | | | | | | X |
| G-22 | | | | | | | X |
| G-23 | | | | | | | X |
| G-24 | | | | | | | X |
| G-25 | | | | | | | X |
| G-26 | | | | | | | X |
| H-18 | | | | X | | | X |
| H-18B | X | NN | Crawlspace | X | X | X | |
| H-19 | NN | X | NN | X | NN | NN | |
| H-20 | | | | | | | X |
| H-21 | NN | NN | NN | X | NN | NN | |
| H-22B | X | X | NN | X | X | NN | X |
| H-40 | | | | | | | X |
| J-39 | | | | | | | X |
| J-43 | NN | X | X | NN | NN | NN | |
| J-45 | X | NN | X | X | X | NN | |
| J-47 | | | | | | | X |
| J-48 | | | | | | | X |

G.WOODWARD RESTORATION SERVICES LTD.
SPECIALIZING IN INSURANCE RELATED REPAIRS
1109A WINNIPEG AVE.
WINNIPEG, MANITOBA R3E 0S2
PH: (204) 783-6266 FAX: (204) 772-5422

***THE FOLLOWING IS A BREAKDOWN OF THE TASKS THAT MAY HAVE BEEN PERFORMED IN YOUR RESIDENCE***

1. SITE WAS PRE INSPECTED TO DETERMINE THE SEVERITY OF THE MOLD
2. ANTI MICROBIAL AGENTS WERE APPLIED TO ALL AFFECTED AREAS PRIOR TO ANY REMOVAL OR CLEANING
3. SEALED OFF THE MAIN FLOOR AREA TO LIMIT SPORE MIGRATION
4. TURNED OFF THE FURNACE AND CREATED A NEGATIVE AIR ENVIRONMENT THROUGH A BASEMENT WINDOW TO LIMIT SPORE MIGRATION
5. REMOVAL OF ALL AFFECTED BUILDING MATERIALS IN THE BASEMENT TO INCLUDE DRYWALL, PANELING, STUDS, ETC.
6. WRAPPED ALL DEBRIS PRIOR TO IT LEAVING THE BASEMENT TO LIMIT SPORE MIGRATION
7. SWEPT ENTIRE AREA AFTER ALL BUILDING MATERIAL WAS REMOVED
8. PRESSURE WASHED ALL CONCRETE WALLS AND FLOORS AND APPLIED ANTI MICROBIAL AGENTS
9. HEPA VACUUMED ALL JOISTS AND APPLIED ANTI MICROBIAL AGENTS
10. INSTALLED, MONITORED AND REMOVAL OF DRYING EQUIPMENT
11. POWER VAC ENTIRE FURNACE AND DUCT WORK TO INCLUDE APPLICATION OF ANTI MICROBIAL AGENTS
12. CLEAN AND DISINFECTED ALL WALLS, CEILINGS, WOODWORK, WINDOWS AND FIXTURES TO ENTIRE MAIN FLOOR
13. CLEAN AND DISINFECTED ALL CONTENTS TO ENTIRE RESIDENCE TO INCLUDE APPLIANCES
14. CLEANED AND DISINFECTED ALL FLOORING ON THE MAIN FLOOR AND SECOND FLOOR
15. INSPECTED ALL PLUMBING
16. INSPECTED ALL ELECTRICAL
17. CLEANED CISTERNS WHERE APPLICABLE

Association of Specialists in Cleaning and Restoration

WLI Water Loss Institute

INSTITUTE of INSPECTION CLEANING and RESTORATION CERTIFICATION