Marijuana Grow Operations

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Introduction

Hardly a day, it seems, goes by without mention in the news media about illicit activity involving marijuana and other prohibited substances. Art Johnson wrote about marijuana grow operations in a previous issue (Grow Ops – A Remediator's Perspective on the Latest "Cash" Crop, Cleaning & Restoration, Volume 42, Number 1, January, 2005). Art focused on the situation from the perspective of a building restoration company. A review of the situations and circumstances that Art discussed would provide a solid background to this discussion. (This article is available for download from www.canstarrestorations.com.)

The underground economy of which marijuana grow operations are a major part creates huge distortions in the legitimate economy in local jurisdictions. Several years ago, Canada was estimated to have 50,000 marijuana grow operations, of which 20,000 were believed to be in the province of Ontario and 15,000 in the Vancouver area. The net impact was estimated to contribute an unregulated and untaxed $5 billion through the underground economy in Ontario. The distortions to the legitimate economy occur where that money goes and how it is spent and how it influences the cost of items purchased through the legitimate economy.

For most Canadians, it is profoundly embarrassing to have to acknowledge that marijuana is an exporter's dream. A product worth an estimated $2500/lb in Ontario fetches about $7500/lb in the US. Enforcement of existing laws is lax and penalties are light and meaningless.

A Wake-up Call

On Jan. 12, 2004, police in Barrie, Ontario, a dormitory city for Toronto swooped down on a shut-down brewery south of the city in a raid that received world-wide attention. This raid netted 30,000 marijuana plants with street value estimated at $30 million. Police estimated that this operation could do $100 million per year in business and employ around 50 workers. This operation covered 60,000 ft^2 in the disused building and involved miles of tubing for hydroponics and 1000 lights. This certainly was the largest operation of its kind ever uncovered in Canada and perhaps in North America. It hopefully forced attention

to focus on the magnitude of the situation.

Municipal Response to the Problem

Following much frustration in the Vancouver area with marijuana grow operations and illicit methamphetamine and other drug production, many of the local municipalities finally took action, starting with the City of Chilliwack in October, 1994. The writer had the dubious distinction of working on the first houses affected by the first and subsequent 'grow-bust' bylaws in several of the local municipalities.

This bylaw, and several of its iterations in other municipalities impose a number of burdens on the property owner. These include removal and disposal of all carpets and curtains or cleaning of all carpets and curtains by a Professional Cleaner or the homeowner. Another is to have all ducts in a forced air heating system cleaned by a Professional Cleaner or by a duct cleaning company. And a third is to have all walls and ceilings cleaned by a Professional Cleaner or the homeowner.

The preceding requirements are straight-forward technical requirements. The bylaws also require inspection of the building and provision of written certification by "an individual or corporation certified by the CRBOH or ABIH" or certification by a "CIH or ROH or Environmental Engineer that the subject premises is free of …", or in another form, "premises is (substantially) free of any pesticides, fertilizer, toxic chemicals, moulds, fungi, or other foreign materials related to grow operations" (grow operations include methamphetamine production)". To explain the initials, CRBOH is the Canadian Registration Board of Occupational Hygienists; ABIH is the American Board of Industrial Hygiene; CIH is Certified Industrial Hygienist (certified through ABIH); and ROH is Registered Occupational Hygienist (registered through CRBOH).

The gist of the preceding is that an individual holding (a) technical credential(s) recognized in the community is required to complete and sign a legal document. Documents of this sort put these individuals into considerable legal jeopardy.

The bylaws mentioned here impose considerable burden on the owner of the property. So, who is this? Well, property owners naturally include homeowners, but they can also include condominium corporations, owners of high-rise apartment buildings, and owners of commercial and industrial buildings. A condo owner who sublets to another person who, in turn, sublets to the actual grower could forfeit a down payment on the suite or townhouse, potentially leaving the condominium corporation to address the problem. Owners of high-rise apartment buildings or other similar large properties and commercial and industrial buildings are especially at risk from this kind of activity because of lack of surveillance of the affected properties.

Business Operation and Business Decisions

Organizations behind some growers set up pseudo-businesses in existing buildings and storefronts. They perform all of the activities of legitimate businesses, including leaving behind decals and signage of previous tenants on windows and walls. Visitors therefore could expect to see actual business equipment and the normal trappings of a business starting up or starting up in a new location. These could include boxes nominally containing equipment related to the legitimate business. The legitimate business maintains a low profile.

As time progresses, a quiet transition to actual intent occurs. This includes removal of unnecessary equipment. The illicit activity uses the boxes and packaging containing labels of the legitimate operation for handling the plants. Grow equipment and fertilizers are purchased from specialized suppliers. Other supplies and equipment are obtained from regular sources (soil, lumber, etc.) where the purchases raise no attention.

Legitimate businesses in the area quickly identify that activity associated with this 'business' makes no sense. This is especially easy where the operation is set up in an industrial strip mall. Other business operators can readily identify the obvious lack of economic activity that is essential for the survival of a

true business. Other giveaways of things abnormal include the type of person and associated vehicles that frequent the premises and the hours of the day in which this activity occurs.

These operations are set up with the expectation that sometimes someone will be caught during production activity. The proponents use a number of strategies to minimize the likelihood and impact of these situations. The first involves subletting. The original contact with the building owner or property manager sublets to a second individual. The second individual sublets to a third and possibly even to a fourth person. The first person gains distance from the person involved and possibly the activity undertaken and ultimately may legitimately claim to have no knowledge about either. The second strategy is to set up operation for a single crop. A single harvest avoids overt suspicion about power usage especially in an industrial location, and the potential for detection due to emission of heat from the roof. Electrical utilities know exactly where excess consumption is occurring through records of properties and actual measurement at the utility pole or other means.

Winners and Losers

This situation creates major distortions in the economic health of a region. Some people amass large amounts of money very quickly with minimal effort. For those few winners, there are many losers, starting with renters of accommodations, the people through economic circumstances who choose to or are forced to rent property. Rental property is becoming scarce. This is a direct cause of homelessness.

Homeowners who rent property to others as landlords have learned some very harsh lessons from this experience. Costs associated with clean-up and the payment of fines and service charges to the municipality can easily amount to $50,000. The net outcome from this situation is to reduce the availability of rental housing stock. Renting of property becomes a losing high-risk proposition as desirable tenants also become scarce. Landlords have reported becoming afraid to evict the undesirables among the remaining tenants from fear for their own safety and the safety of their property.

Customers of the electrical utility lose through theft of power. BC Hydro (the hydroelectric utility that serves most of BC) has estimated losses of $50 million per year due to marijuana grow operations. The utility must recover these losses through collection of additional money in the bills of paying customers. Similar estimates exist for cities in Ontario.

Municipal taxpayers lose through loss of assessed value of property. Properties involved in grow operations experience a discount in value in the market as a penalty for this activity. People are afraid to move into a house known to have been involved in marijuana grow operations from fear for their own health. There is also the residual risk of targeting of the property by criminal elements not informed through their ‘grapevine’ that the property is no longer involved. The new or existing owner must declare on the real estate documents at time of offering the property for sale about its use in a grow operation. This stigma is likely to follow these properties for years to come.

The costs of marijuana grow operations extend considerably beyond the economic ones. Records indicate that grow houses are 40 times more likely to experience a fire than regular residences. Fifteen growers in British Columbia (BC) were electrocuted. Two carpet cleaners working in a former grow house in BC were poisoned recently by carbon monoxide (CO) emitted by a portable generator. (The electrical power is often cut-off by the affected municipality as part of the grow bust.) Thus far, there is no mention about fatalities involving police, fire, and municipal workers in the conduct of their duties with grow operations. While the preceding may not offend the sensibilities of many, disturbing perhaps to them is the involvement of children who live in grow houses, an estimated 245 to 2450 in Ontario.

The biggest losers in all of this are the people who live and work in buildings formerly involved in marijuana grow operations. These buildings often change hands without any formal recognition of the situation and attention to it. The end-result can be the onset of serious respiratory and other symptoms in the new owners or their families or other occupants. Without prior warning about the history of the building, this situation can have a devastating impact on the lives of these people.

Who does not pay in these situations? Well, the criminal, for one, because enforcement of existing laws is lax and penalties are meaningless. Insurance companies don t pay either. These are crime scenes and usually are not covered by property insurance, unless the deductible is very high ($10,000).

Marijuana Grow Operations

So, let's go back to the beginning. Some knowledge about this 'industry' is useful in understanding how to approach the indoor environment following a 'bust'.There are three main cultivars of marijuana: *Cannabis sativa*, *Cannabis indica*, and *Cannabis ruderalis*. Each has different appeal to growers and breeders and different growth requirements. Optimizing growth in the indoor environment therefor requires mimicking climatic conditions in the region of origin.

C. sativa originates in southern African. It grows 14 to16 ft (4.3 to 4.9 m) high in skinny growth habit in a hot, dry climate. The growth cycle requires 12 to 16 weeks. *C. sativa* produces the highest level of cannabinoids. *C. indica* originates in the Middle East. It grows to about 4 ft (1.2 m) in height in a short, bushy growth habit. *C. indica* is more robust than *C. sativa*. It will grow in any climate, including outdoors in North America. *C. indica* has a growth cycle of 8 to 10 weeks. When cultured in hot humid climate, there is a risk of mold growth. *C. ruderalis* originates in Eastern Europe/Russia. It grows to about 4 ft (1.2 m) in a short, not so bushy growth habit. *C. ruderalis* grows in cold climates in a 6 week growth cycle.

Plant breeding is an integral part of this 'industry' and why the current situation exists. Much of this effort involved hybridizing *C. sativa* and *C. indica*. Plant breeding has created high yield of cannabinoids compared to what was available years ago, quick growth, survivability in the outdoor climate, resistance to mold and insect/arachnid infestation, and dense, full buds. In other words, these plants constitute the mother lode of this 'industry'.

The sophistication of a grow operations is constrained only by the area available for cultivation. Sophisticated grow operations use different 'rooms' for each stage: seedling, vegetative growth, flowering, and drying. The environment in each area mimics that encountered in the wild and optimizes conditions.

Growers sprout seeds or purchase cloned plants. Growers germinate seeds in 'jiffy' pots (peat pots that expand when wet). Seedlings require full-spectrum fluorescent lighting, 18 to 24 h/day. Cloning is another technique used by breeders and growers. Cloning involves clipping small branches from the mother plant prior to flowering, applying rooting gel and illuminating under full-spectrum, fluorescent lighting for 18 h/day

Vegetative growth usually occurs under high pressure sodium lights (preferred), although metal halide lights are also used. These are the types of lights typically seen in photos of grow operations. The growers use reflectors on the lights and on surfaces of walls to concentrate the lights onto the plants. This also minimizes loss from absorption of light by nonproductive surfaces. The lighting regimen is strain specific, around 18 h/day to mimic the summer condition. At this point in the growth cycle, temperature is highest.

Marijuana growers use various techniques for growth as do other indoor growers. These include hydroponics, drip irrigation and pots. Hydroponic growth is soil-less and utilizes nutrient solutions. Drip irrigation employs beds of soil and hose/tubing to deliver precise amounts of nutrient solution to the plants through tiny spray heads similar to those found in the produce section of the supermarket for maintaining vegetables in crisp condition. This technique allows the operation to occur in semi-automated fashion, thus minimizing the need for human involvement. Pots containing soil are the traditional method. These require watering from a hose or other means of supplying water.

During bud formation, high pressure sodium lighting is preferred, although again, metal halide lamps are also used. Again, the lighting regimen is strain specific, about 18 h/day to mimic the late summer/fall condition. Temperature is maintained lower. Male plants are excluded from the growth cycle to encourage production of resin by the female plant.

Collecting the visible crystals of dried resin (oozing sap) on the buds occurs during harvesting. Growers

lower the temperature to crystallize this material and to minimize loss due to vapor formation and condensation onto other surfaces. The grower cuts and dries the buds, and sieves them to separate the crystals which are pressed to form hashish.

Drying occurs on racks containing screens or other suitable surface with high surface area that allows free movement of air.

The grower utilizes chemical extraction and distillation to extract resin and sap from leaves and plant parts. Extraction chemicals can include highly volatile fuels, such as butane, or isopropyl alcohol. Performed in an enclosed building envelope containing uncontrolled sources of ignition, these activities occur at great risk of fire and explosion. In a normal building, the pressure developed during an explosion in this situation could blow out windows, skylight panels, doors, and possibly cause severe structural damage. Severe injury or loss of life in such events is to be expected.

Plant nutrition is an important consideration in marijuana grow operations. Fertilizers contain soluble compounds of nitrogen, phosphorus and potassium (NPK), as well as trace elements. Nitrogen is usually found in ammonium (NH_4^+) compounds. Phosphorus is present in phosphates (PO_4^{3-}). Potassium (K^+) is present in potash (potassium sulphate). The amount of research expended in optimizing growth of marijuana plants through nutrition is readily evident from the variety of containers of these products observed at sophisticated grow operations.

Marijuana grow operations are the target of plant pests. Foremost among these are the fungi, more importantly the molds. Molds grow in soil and on leaves. Individual families and members within families prefer specific zones of humidity. Most prefer room temperature. Hot, humid conditions promote growth of mold and especially, pathogenic fungi (*Aspergillus* family). Hot, humid conditions arise from the heat emitted by lights and hot, humid combustion gases produced by propane heaters or ducted into the growth chamber from gas furnaces. High moisture, as provided by hydroponic systems, enables growth of yeast.

Marijuana grow operations are susceptible to pests found on other plants. Pesticide use in marijuana grow operations is not certain, and if used, would be used to kill leaf-eating and sap-sucking pests. These include insects and arachnids (spider mites). Insects, pets, and clothing carry the eggs. These pests lay eggs and grow on underside of leaves. They prefer a temperature range of 77° to 95° F (25° to 35° C) and low humidity. Egg to egg lying can occur in 8 days. Hence, these pests can cause havoc with a ‘crop’ in a very short span of time.

Pesticides likely are purchased locally, as they are legally obtainable from garden supply stores. Pyrethrins are the recommended miticide. Spray application should occur from the underside of the plant. Overuse could taint the crop. Spray applied to the top side of the leaves or broadcast in a way that covers all surfaces in the grow area is ineffective and wasteful. Hence, spray applied in the grow area should be present near the floor because the plants are not tall.

Pesticide remnants on low-level surfaces of walls and floors due to overspray and spills include pesticide residues and conversion products. Some conversion products are more toxic than the pesticide itself. Conversion occurs through reaction with oxygen in the atmosphere and action by microorganisms. The pesticide screen available through lab analysis detects 87 pesticides.

Greatest risk of exposure applies to the applicator. Products sold for home use are formulated to minimize risk. The risk posed by remnants decreases with time. An odor is often present . The odor threshold of many pesticides, the concentration in air at which most people can detect it by nose is less than guidelines for exposure, such as the TLVs (Threshold Limit Values).

First and foremost, marijuana grow operations are businesses. The conduct of these businesses is motivated and mediated through business decisions. These begin with the decision to grow marijuana and progress to what kind, where to grow it, the logistics of how to do it, and finally to marketing of the product.

The economics of grow operations include set-up, estimated typically at $15,000 to $20,000, grow time of 30 to 45 days minimum, but more typically 3 months. Typically, there are two plants per 1000 W high pressure sodium bulb. Each plant yields 1 lb (0.5 kg) of marketable marijuana, the output being about $2000/ plant/ 3 months at a cost of $150/month/high pressure sodium light for electrical power. Dried marijuana easily sells for $3000/lb ($6000/kg). Factored into the business decision is the fact that there is small risk of being caught and an insignificant penalty when this occurs.

The growing of marijuana in buildings is a highly organized and technically sophisticated endeavor. Creativity is readily apparent everywhere in these operations. 'Consultants' and trades people set up the operation for would-be growers Electricians perform the wiring. The consistency in this work, recognizable from building to building, suggests involvement of a limited number of individuals.

These operations use process control to regulate and optimize growing conditions: temperature, lighting, delivery of nutrients, and the level of carbon dioxide and humidity. A heat exchanger controls temperature. Lighting is controlled through timers, and use of reflectors and reflective surfaces. Chemical sensors monitor delivery of nutrients. Atmospheric sensors monitor CO_2, O_2, and temperature. Propane-fueled heaters consume O_2 and produce CO_2. In less sophisticated operations, the grower ducts combustion gases from the furnace or hot water heater into the grow room. These enhance the level of CO_2 (greenhouse gases anyone?), and create high humidity and possibly provide some CO. Exhaust fans draw air through charcoal adsorbers to remove volatile compounds, and hence the odors.

The ducts pass through openings created in floors in rooms, closets and ceilings into attic and roof spaces where discharge occurs discretely through existing openings in the roof. Humid air discharged into the attic or roof space can promote growth of mold in these areas. The grower also may utilize fireplace flues as a discharge. There is no evidence from the street about the activity that is occurring in the building. Repairing such damage is an important component in restoration of the building.

Once set-up in a building, a marijuana grow operation is subject to a number of external influences. A residence offers considerably more privacy than a business operation. A residence is subject to inspection by the landlord. Privacy requirements limit the frequency and timing of these inspections. The landlord or property manager must make an appointment with the tenant. After the delays normally incumbent in such procedures, the grower has ample time to assess the risk of detection and to take appropriate action, up to and including dismantling the operation, removing the plants, and abandoning the location prior to arrival by the landlord or property manager.

Marijuana grow operations established in commercial and industrial locations are much less secure. These face unfettered access from labor inspectors, public health inspectors, fire inspectors, gas emergency inspectors and access following obvious disasters, such as rupture of water lines and flooding of the premises.

In other situations, notice is required from the inspecting agency and the owner or property manager. Other inspection groups include plumbing and electrical inspectors. Notice for these inspections may be as little as 24 hours. Interestingly, the police require a search warrant.

Other possible influences include callers who arrive unpredictably at the site of the operation. These can include door-to-door sales people, canvassers, letter carriers and couriers, and in the case of operations set up in business locations, potential legitimate customers. Callers also can include rivals and potential enemies.

Growers use such diversionary tactics as 'secret product development', or 'dangerous activity' or delaying tactics including the demand to return with a search warrant (24 to 48 h to obtain) to delay the inspection as long as possible. If threatened, the grower will abandon the site. The plants are worthless if not in bud. In severe circumstances, the grower might even burn the building to destroy evidence containing fingerprints or DNA

Grow Busts
Police approach such situations with considerable caution and exercise due diligence. They identify the parties in advance through intelligence and observation. This work can require weeks to months of information-gathering. Such research includes background and criminal checks to determine potential for: violence. This includes a risk assessment to determine the likelihood of the presence of guns and other weapons.

Police attempt to enter when the building is occupied. The operation involves at least 7 or 8 officers, one marked car and cover of both the front and rear of building. Six or seven officers break down door using a ram and enter with guns drawn. Growers know about these tactics and often barricade doors with 2x4 timbers held in place by brackets mounted on the frame.

Police operations are risky because booby traps are possible. These have included beds of spikes positioned at the foot of stairways, trip wires connected to shotguns and bare 220 V wires on stairway bannisters.

During follow-up operations, the police contact the fire department and the municipality to make available building inspectors to visit the building to identify deficiencies. They also call the electrical utility to inspect the service drop, and as appropriate, to cut off power at the pole, and the gas utility to cut off the supply of natural gas.

This situation leaves the building completely vulnerable and without the protection normally available from alarm systems. These buildings soon come to the attention of copper scroungers and other thieves. Stripping of copper pipe and wire from these buildings is not uncommon. The latter activity can lead to major destruction of existing walls, in addition to flooding from a water supply valve left turned on with no connected piping.

Building Restoration and Marijuana Grow Operations
The legitimate building restoration industry and OH&S practitioners who sign off documents on these buildings are spectators to all of this. The set-up often remains following the ‘bust’. The police focus their interest mainly on the plants. However, when equipment marked as evidence and auctioned off appears in a subsequent grow operation ...

Just as setting up marijuana grow operations has led to creation of an underground industry, so also has remediation of these buildings following the ‘bust’. Transactions in this arena tend to be done in cash. One accustomed to having perhaps $100 in cash in one’s wallet instantly reaches a heightened state of awareness when handed 125 twenty-dollar bills in payment for testing and inspection services, with the request to have everything completed yesterday, in order for the house to be available for some special event coming in a few days.

Marijuana grow operations pose a number of issues in building restoration. To begin, these are crime scenes. As a result, they can contain previously undiscovered weapons and evidence left in less accessible locations, such as attic and roof spaces and crawlspaces. The buildings can contain undiscovered booby-traps, as well as a nuisance and potential hazard of another sort: squatters. Squatters soon learn about the existence of unoccupied buildings. Visitors to the premises, especially those driving unmarked vehicles can attract attention from former customers, rivals and enemies.

Reliance on portable generators, a result of the loss of installed power, can result in CO poisoning of workers in the building, as well as residents of adjacent properties where buildings are located close together when air circulation does not occur. Theft of equipment, especially the generator, is an ever-present reality. This can easily occur when work occurs remote from the service vehicle.

Restoration of these buildings typically costs in the range of $20,000 to $25,000 for commercial units and $4,000 to $8 000 for dwellings (2 rooms + basement). The cost of testing for mold and the pesticide screen is around $3,000. There is no guarantee that a single visit is all that is needed. Detection of

excessive spore levels or detectable pesticide residues could necessitate an additional visit. The municipality assesses additional costs that can easily exceed $10,000.

Involvement of the OH&S professional with these buildings usually begins with a telephone call from the owner or owner's representative. They often indicate that the building is ready for testing and enquire about the cost. They are impatient on learning that the testing is very expensive, and that more than one visit may be required. Some back out after receiving detailed instructions on preparing the house in favor of a rock bottom price, that obviously reflects a substandard approach to the challenge of evaluation.

The OH&S professional, on arriving usually sees an empty house, sometimes with carpet removed, sometimes not. (One municipality requires removal of all carpet. While seemingly draconian, this usually does simplify the testing situation, since only hard surfaces remain. There is nothing, however, to prevent reinstallation of the carpet which is usually left outside in a garage or carport open to the weather.) Sometimes the houses have new carpet and are newly painted in preparation for sale. Walls in affected areas are repaired and painted in some cases and left open in others. Repainting prevents assessment for possible damage underneath.

The inconsistencies illustrated in these situations present a serious dilemma to the OH&S professional intent on maintaining professional integrity. For a start, there is no ability to provide a consistent approach. Involvement at the end of the process prevents evaluation beyond the most superficial. There is no ability to examine the building in its raw state or as close to the raw state as possible following the grow-bust nor access to wall cavities in these situations. As a result, this creates the unacceptable situation of having to pass judgement on a dwelling without having the full means to ascertain soundness or suitability or thoroughness of the repair work. As well, working alone with unknown people, arriving in an unmarked vehicle and the possibility of receiving a large amount of cash for the work, despite the request for payment by check, creates a situation of unacceptable risk.

The only feasible solution in this situation that protects the interests of everyone is a partnering relationship between the legitimate building restoration companies and the OH&S professional. Working together, both groups can approach the problem in an organized, strategic manner. Personnel from the restoration company effectively become the eyes and ears of the evaluator regarding the status of the building during the clean-up. They have training appropriate to addressing mold hazards in buildings and understand necessity for and have the tools for performing the thorough cleaning that is required and understand the role of moisture from all sources in this problem.

Formation of a partnering relationship between the building restoration companies and the evaluator enables a consistency of approach for both groups. This should lead to an understanding of what is required, what is desirable and what is achievable. This will protect and enhance the interests of both groups.

The first issue to consider is the bottom line for success in this endeavor. That is, what issue has the greatest potential to cause the greatest grief? What are most likely to trouble new occupants of a building involved in a marijuana grow operation are building-related allergic symptoms caused by the presence of fungal spores.

Spores produced by fungi pose allergenic hazards expressed through symptoms occurring in the eyes and respiratory system. The eyes, nose, and throat experience hay fever-like symptoms. The middle airways can develop allergic asthma. The alveolar region can develop extrinsic allergic alveolitis (also known as farmer's lung and hypersensitivity pneumonitis). Remediation work also aerosolizes large number of spores.

Among the fungi are opportunistic pathogenic fungi, those that can cause disease. Common fungi tolerant of body temperature in the mouth and gastro-intestinal (GI) tract include *Candida albicans*, a type of yeast. Some members of the *Aspergillus* family can colonize the respiratory system, GI tract, brain, liver, and kidneys. The success of infection depends on the immune status of individual. *Aspergillus* infections are very difficult to treat.

These realities mean that the building must be as clean as possible and as dry as possible, or said another way, ‘cleaner than clean and drier than dry’. Spores from a marijuana grow operation are present throughout the airspace of the building and will settle in carpets, drapes, fabrics, and on surfaces in uninvolved areas. Spores due to fungal growth unrelated to the marijuana grow operation are also present in the building envelope. Fungi related to the marijuana grow operation are not necessarily distinguishable from those due to historic growth or growth occurring for other reasons. Localized differences in spore type and distribution are often discernable by room, floor or area in a building. Higher spore levels are often present in areas uninvolved in the grow operation because of inadequate attention to cleaning.

Moisture issues in a building have a major impact on the assessment of the status of a marijuana grow operation. Existing moisture issues can cause growth unrelated to the marijuana grow operation. These can arise from leakage through roofs and walls, and around windows and doors; leakage from plumbing and fixtures; and seepage through walls and dirt floors into basements and crawlspaces. Without correction, this growth will negate efforts to clean up the marijuana grow operation.

The requirement to complete a legal document regarding the status of a building, in effect, directs a spotlight onto the building. The only protection available to the evaluator and the other parties participating in the process is to ensure that the building cannot perform any better in quantitative testing than any other building. In practical terms, this means that the indoor environmental quality in a marijuana grow house in a subdivision must be superior to that of any of its neighbors, and as good as achievable by normal technical means. This standard provides an unassailable defence of the work and the assessment of it.

The next aspect to consider is the actual work to be performed in the building. Grow areas in these buildings acquire and retain a characteristic odor, described as ‘skunky’. Police recognition of this odor outside the building is an indicator of the potential presence of a grow operation. Workers entering these buildings to perform the initial stages of clean-up have reported becoming intoxicated.

Many growers sheath the growth chamber in sheet poly(ethylene) and other plastic materials, some containing reflective surfaces. Reflective surfaces minimize loss of light by absorption and retain the heat. Growers know that police use infra-red thermography as a method of detection. Some growers dismantle the grow area prior to vacating the premises and moving on. The grow area is often readily recognizable from remnants of tape and staples left behind in surfaces.

Plastic sheathing can assist and hinder in the process of building restoration and testing. A sheathed, enclosed area potentially protects surfaces located behind the impervious layer. Removal of the plastic layer eliminates the surfaces on which pesticide remnants may be present and can eliminate the need for the pesticide-screen test.

The status of wall cavities in rooms containing drywall in these rooms is not known. The presence of a layer of plastic greatly reduces the potential for growth of mold on these surfaces. Where such protection is not available, the high humidity and temperature which are likely in grow rooms promote growth on exposed surfaces of drywall and in the wall cavities behind the drywall.

One option in these situations is to remove the drywall. Where there is no evidence of growth on the exposed side of the drywall, inspection of the wall cavities through test holes may be more appropriate. Drywall mud and texture material can contain asbestos. Hence, testing for asbestos is necessary. Removal of drywall provides access to the wall cavities for inspection and eliminates surfaces on which pesticides may be present. This avoids the lab fee for the pesticide-screen test (around $800) and reinvests this money into the building.

First-hand knowledge about the status of the grow area at the time of the bust provides an important consideration in these decisions. This can originate from photos taken by regulatory agencies and made available to the building owner. Sometimes the owner is a witness to the scene at the time of the bust. Information describing the status of the grow area volunteered without prompting provides important input.

Remediation work in marijuana grow operations is similar to that performed in other mold-infested

buildings. Industrial buildings with open space to the roof may be amenable to powerwashing. Site security may be an issue in large-scale projects because of the possible return of tenants or friends or enemies to reclaim equipment.

The grow area may require special attention because of deposition on surfaces that creates the 'skunky' odor. This problem may be solvable through use of cleaners that exploit solubility of these materials, deodorizing techniques or removal of existing surfaces.

How Clean is Clean Enough?

So, how clean is clean enough? For pesticides residuals on surfaces there are no limits against which one can make an assessment. Pesticides can be removed by further cleaning on detection or by removal of the surfaces on which they were discovered in a random sample. Hence, less than the limit of detection seems to be a reasonable point of judgement unless there is some valid reason to the contrary. Some of the pesticides are legally present in consumer products or paints used in older homes.

The substances found in fertilizers are present in foods and common household cleaners, as well as dust and aerosols in outdoor air. This is especially the case in an agricultural community. As a result, attempting to differentiate between fertilizers and other possible sources for these substances is technically impossible and of questionable value. Since these substances are water-soluble, cleaning and painting will obliterate deposits of these substances resulting from the marijuana grow operation.

With regard to fungal spores, the level in the dwelling should be the same as experience has shown for other clean, dry dwellings not involved in marijuana grow operations. Experience has also shown that restoration companies can achieve phenomenal results with dwellings involved in marijuana grow operations through diligent cleaning compared to uninvolved clean, dry dwellings.

Assessment of fungal results is complicated by the observation that outdoor levels and populations of fungal spores are weather-dependent. Some of the variables that influence spore levels include wet versus dry weather, windy versus calm conditions, sub-freezing versus temperate conditions, and media choices for culturable samples.

As a general rule, airborne levels of culturable and total fungal spores should be as low as reasonably achievable (ALARA). As low as reasonably achievable does not necessarily imply zero. For certain types of spores not normally observed in air samples, the level effectively should be zero. For fungi of greatest concern (*Stachybotrys*, *Fusarium*, *Trichoderma*, *Memnoniella*, *Chaetomium, Aspergillus flavus*, *A. fumigatus*, *A. niger*) which are not normally encountered in outdoor or indoor air, the acceptable level should be zero or very close to it.

At this point, discussion about the role of portable ventilation in achieving target levels is appropriate and necessary. Portable ventilation plays a key role in meeting targets for airborne spore levels. The point of setting targets rather than absolute levels for airborne spore levels is to focus attention on realistic achievement of cleanliness. This helps to avoid the 'parlor tricks' and 'sleight-of-hand' that are achievable by portable ventilation equipment. Use enough units in the enclosed area operated in recirculation mode and just about any target is achievable. What matters ultimately is the status of the building the day after the project is complete and the equipment is removed and the existing fixed ventilation system takes over again.

For fungal spores on surfaces and in bulk materials, as low as reasonably achievable is a realistic target for thorough cleaning.

Mycelial fragments, reported by some labs are fragments of the growing fungal plant. They provide an invaluable indication about the status of fungal growth at the time of sampling. Mycelial fragments are seldom present in outdoor air samples. With regard to their presence in indoor air, they also should not be present unless growth is continuing. Continuation of growth likely indicates the presence of a source of moisture and that remediation is not complete. Hence, levels of mycelial fragments in indoor air should be

as low as reasonably achievable at the end of the process

ALARA is achievable through careful attention to detail in the application of fungal remediation principles. Work involving former marijuana grow operations is complex and involves real risks to the health and safety of all participants. They can be controlled through knowledge and application of a systematic approach to hazard management

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Disclaimer. The author has had no involvement of any kind direct or indirect in any aspect of marijuana grow operations. He has had direct involvement in the rehabilitation of buildings directly affected by the activities described herein, but no involvement in the activities themselves.