CANNA MARKETS GROUP

# Hemp-Lime, Flood Resilience, and Historic Building Performance

## A Field Case Study from Historic Ellicott City, Maryland

### Practitioner Testimony: Gayle Killen

Natural Building Practitioner, Ellicott City, Maryland

**Interview, Compilation, and Field Documentation**

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## Introduction

When three so-called “thousand-year floods” swept through Historic Ellicott City, Maryland, in just seven years, many neighbors rebuilt their homes and businesses only to watch them flood again. Gayle Killen took a different path. Drawing on decades of studies in natural building and hands-on training with hemp-lime pioneers in North America and Europe, she transformed her 1809 stone house and 1888 balloon-frame addition into a living laboratory for flood resilience, indoor health, and community learning.

In this conversation with **Canna Markets Group (CMG)**, Killen explains how hemp-lime performed through repeated disasters, what it taught her about emotional sustainability, and why she believes this material can help historic buildings survive for centuries.

## Field Summary: Practitioner-Derived Insights

This interview documents nearly a decade of firsthand experience retrofitting a historic residential structure with hemp-lime in a flood-prone environment. Rather than presenting a controlled laboratory assessment, the conversation captures practitioner observations across multiple flood events, material applications, and building conditions.

**Key insights emerging from this case study include:**

- Hemp-lime demonstrated repeated post-flood recovery without loss of structural integrity, including visible moisture migration followed by self-drying behavior over time.
- The material's hygroscopic and vapor-permeable characteristics appeared to reduce long-term dampness and mold risk compared to conventional insulation systems.
- Reinforcing historic walls with hemp-lime contributed not only to thermal and moisture performance, but also to impact resistance and acoustic buffering.
- Retrofitting with breathable materials proved particularly relevant at transition points between dissimilar building systems (stone, timber, balloon framing).
- Community-scale recovery may benefit from materials that reduce rebuild cycles, simplify repairs, and allow occupants to visually assess material condition.
- While long-term observational evidence is strong, the absence of formal instrumentation highlights a clear opportunity for future monitoring, research, and insurer engagement.

This case study does **not** claim universal applicability, code equivalence, or performance guarantees. Instead, it offers documented lived experience intended to inform further inquiry, testing, and policy discussion.

Readers interested in the full technical, experiential, and contextual detail—including flood event narratives, retrofit methodology, historic preservation considerations, and demonstration-site vision—are encouraged to read the complete interview below.

# Origin Story and Material Discovery

**Canna Markets Group (CMG):** You've described your journey into natural building as both a homeowner and an experimenter. What first convinced you that hemp-lime was the right material for your home, and how did you navigate the early challenge of sourcing it?

**GK:**
I took my first natural building workshop from Sigi Koko sometime around 1996. I dropped out of engineering school that same year and accepted an apprenticeship in the building trades that had just opened up at the university. The university was a playground of building types and materials where older structures integrated state-of-the-art technology.

I'd been working part-time for the lock shop since high school and was already learning so much from co-workers in HVAC, plumbing, and electric. I enjoy training with workshop crews and trade crews alike—usually a collection of solo builder–crafter types like myself. Ideas get born in these kinds of cross-community information exchanges, and I'm able to work what I gather from a greater collective into my home craft.

Once I understood that hemp-lime restorations of older stone and timber buildings were performing in damp-challenged climates such as the UK and Ireland, I could then see it protecting my home.

I bought the house in 2010 and, after the first flash flood in 2011, my focus was mainly on discovering damp and mold in the basement area adjacent to the Hudson Branch floodplain. I had time to consider risks and think about things like bringing utilities up a level and running new electric in MC outside the walls and above the 4' line. I focused on getting rooftop solar approval from the local historic preservation authority and got the basement ready for an overhaul.

But the second flood in 2016 didn't enter the back of the house from the floodplain. Instead, the floodwater infiltrated from the front. Main Street failed and exposed an old coal chute, sending floodwater into a stone utility and workshop space. The stone was, of course, fine—but contents such as utilities, all my tools, and workshop space had been swirled and buried in flood mud.

By that point I had put plenty of research and consideration into my choices and knew what had to be done. I just needed to run my final hemp-lime insulation ideas past some experienced folks in order to feel really ready to go. That led to a few awkward international phone calls, and the resounding comprehension and affirmations gave me the fire to move forward.

The very first bags of hurd and lime binder that I worked with were from one of Sigi Koko's Maryland projects. Every day of the workshop I took materials one car load at a time. I recall feeling nervous I might be pulled over and questioned about hemp. Once I witnessed it set like rock, I ordered pallets from US Heritage in Chicago right away. I'm currently working from my second order from US Heritage.

The industrial hemp building industry has grown, so my next load will come from Lancaster Lime Works in Pennsylvania—so close to home.

**CMG:** When you first began applying hemp-lime around your foundation perimeter, what surprised you most about working with the material compared to conventional construction methods?

**GK:**
Learning to mix the hemp, lime, and water and then cast the wet insulation into the walls was surprisingly simple. The material is shapeable and re-shapeable for a couple of days before it really begins to set in stone. It's forgiving and you've got time to round out or sharpen up corners. It's surprisingly lightweight and a breeze to handle.

The conventional materials I replaced were fiberglass insulation batts and drywall. Those materials were vulnerable to condensed water vapor that ultimately collects on the sill plate. Damage to the connection between the sill plate and wall studs is tragically common when we try to tighten the seal on old walls that were intended to breathe.

The hemp-lime sound insulation aspect was also very surprising. And it became joyfully evident that no critters would be making tracks in these walls again. My father, from a long line of firefighters, was most impressed at how this material serves as fire blocking inside balloon-framed walls.

**CMG:** In your story, there's a clear emotional throughline—resilience, frustration, hope—especially when you talked about being "the crazy panicked person standing in the middle of a disaster." How has this journey reshaped the way you think about emotional sustainability in the materials we choose to build with?

**GK:**
Not knowing what's going on behind walls is a serious concern. Over and over again, we see insurance just barely pay to put things back the way they were, leaving occupants just as vulnerable for the next disaster. Some use all they have to rebuild, many accepting intense debt, to flood again. People in the hardest-hit communities are too commonly marginalized in advance and persist despite being the least protected and served. All it takes is one disaster to test one's mental, physical, emotional, and financial health.

There's a building insulation that you can learn to install yourself. You can buy the materials from local farmers and masons; installing it makes your frame stronger, it will balance humidity levels, and the pH of it won't support mold. Holding this understanding in the midst of chronic floods and fires will turn any regular handy homemaker into a builder on a mission.

Many are forced to make big decisions before understanding what's going on. There's a truly beautiful effect from community disaster where we form friendship bonds and learn how to look out for one another. I have chosen to be here in this challenged place with a goal to get this home shipshape and keep this small bit of floodplain alive.

Some of my immediate neighbors may not be able to discuss hemp in their homes because their loved ones have suffered tragic loss associated with cannabis for generations. Even still, they respect what I'm doing for this home and they relate to my focus on resilience.

The struggle to explain my hemp building renovations to various labor trades was not without complications. In 2016 this was a material never heard of, considered criminal, and nobody understood that I was going to fill walls with a plant that becomes a rock. I was understandably not being understood, and it was frustrating. One guy just couldn't believe that I had no need for wallboard or drywall and put up a nailing strip anyway. An electrician's helper didn't understand the job was to run everything in MC outside the walls and I came home horrified to find him drilling a hole in an 1888 ledger board.

I took the challenges with lots of whisky, and just kept trying to get better at explanations. At the end of the day, I feel safe and grounded in my home. I learned ways to heal my home and myself, and those experiences are helping me help others.

## Performance and Flood Resilience

**CMG:** After experiencing three so-called “thousand-year floods,” your home’s survival is a powerful case study. What specific performance characteristics of hemp-lime proved most valuable in those flood conditions—and what measurable differences did you observe between affected and protected sections of the house?

**GK:**
The first thing you notice in my house after the area floods is that the atmosphere inside stays dry, while outside the entire region goes into prolonged high humidity levels. This kind of post-flood damp gets into everything while mold blooms run amok. This atmosphere persists until a watershed basin finishes clearing rainfall.

It was fascinating to watch water move through a wall after entering an open window. Every day for weeks I felt the slightly darkened area and it felt dry. I punched it and it never lost strength. Eventually the darkness disappeared. This characteristic—where hemp-lime communicates water content visually—provides a homeowner with transparency and time to address issues that might otherwise remain hidden until damages become catastrophic.

Just a few years ago a derecho dropped into the valley and slammed a large walnut limb into the back of the house. The back addition adjacent to Hudson Branch floodplain was originally two separate additions operating as a duplex. Later the two additions were joined and this span between additions is perhaps the most vulnerable part of the structure—or it was, until I witnessed it take this walnut limb.

I was barely in the basement door with my dog when it hit. Nothing shook, muffled by shock absorption I imagine. I could sense something really big had just hit and went outside to have my mind blown. I was late for a scheduled call with a materials expert from USHBA, and I’ll never forget his chuckle when I tried to explain why I might sound a little excited.

Henry Gage Jr. and his partner Sally had done what I was doing in a combo 1700s and 1800s home in Kingston, NY. He says, “Remind me to tell you about the time a car in a high-speed chase bounced off our house.” Tornado warnings were followed by flood warnings and I laughed at myself, considering: do I go up or down for safety? I decided to enjoy the storm from the basement and gazed in wonder upon this amazing wall. I remembered what it was before and remembered how it was so lovingly stitched together by so many beautiful helping hands.

**CMG:** You’ve mentioned that hemp-lime “breathed the water out within three weeks.” Can you explain what that process looked like in practice—how did the walls behave, and what testing or monitoring did you do to confirm recovery?

**GK:**
The walls felt dry from the very start and remained dry, amazingly. I punched the dark areas almost daily but there was no change to strength or form. The wall restored itself.

**CMG:** You spoke about your hemp-lime walls “breathing out” the moisture after the flood. Have you been able to document that process through humidity tracking, thermal imaging, or structural observation over time?

**GK:**
Just structural observations over time. I've got the benefit of living inside my project and working in slow-motion bursts, in sort of a weekend-warrior style. I have been monitoring the frame and siding from the inside for about nine years.

When I first opened the walls, many of the wood framing members were damp but just on the surface. I knew to let the wood breathe before applying hemp-lime. By the third flood in 2018, the home was bone dry, all the exposed wood inside remaining ambient with the whole home. Our local council representative, Liz Walsh, visited just after and told me I had the driest basement on Main Street.

I wish to have technical monitoring at some point. I've cast hemp-lime into walls at different thicknesses and would like to compare hygrothermographic readings.

**CMG:** How do you see hemp-lime fitting into broader flood-zone resilience planning for historic towns like Ellicott City? Could this be a model for future restoration standards in climate-vulnerable areas?

**GK:**
After our first flood in 2011, a neighbor shared his new plan for his basement. He moved the outlets up and said no more drywall below the 4' line. Instead, he installed corrugated metal roofing panels so that in the next flood, it could simply be unscrewed, the wall cavity hosed out, and dried out. Then he pops in fresh insulation batts and puts the metal back up. He did this for two more floods. Most homeowners around here and nearly all businesses suffer the basic insurance contractor specials.

We can reduce risks by moving utilities up and adapt landscapes for new runoff forces.

Hemp-lime insulation is a building material so accessible and so high-performing that it naturally sets the bar for restoration standards delightfully high. Reinforcing existing walls with hemp-lime adds impact strength and resists ambient moisture fluctuations common in river valleys and watershed basins. Hemp-lime damages are less likely and easily patched.

I think this model of stitching up existing buildings is a viable solution everywhere. Disasters are everywhere, climate and civil. There's lime everywhere, too—everyone on Earth has a local version of lime. There are companies creating lime binder products just for hemp-lime insulation. It's also possible to buy local lime and add pozzolans yourself. With some experimenting, you can work out your own custom lime binder recipe tailored for your space.

Hemp hurds are cellulose, and all those wee little air pockets are insulative. This concept works with sunflowers and other cellulose plants, too—the material possibilities are as endless as creation itself. I see the simplicity of hemp-lime construction being plug-and-play for everyone everywhere.

The Lower Sioux Indian Community is farming hemp on land never before considered farmable. Precast blocks and wall panels are deployable anywhere. Spray-cast machines like

Americhanvre in Pennsylvania are making it possible to lift hemp-lime walls with impressive speed. I'm forever a student of natural building and can get quite romantic about materials.

My passion for industrial hemp comes from knowledge of the army of community assets brought forth. This plant provides food, clothing, shelter while restoring soil and atmosphere. That's why in Cansayapi they call hemp the Green Buffalo.

## Technical Insights from a Living Lab

**CMG:** Your property combines stone construction from 1809 with a balloon-frame addition from 1888—essentially two distinct building systems. What did you learn about applying hemp-lime in these different structural contexts, and were there adjustments you would recommend to other builders?

**GK:**
A most vulnerable space in a building is where dissimilar materials meet—between stone structures and wooden additions, between stone foundations and wooden sill plates, and the spaces around windows and doors. These areas are prone to decay and can foster unwanted infiltration.

The conventional materials I removed from these spaces were mostly spray foam while some cavities were stuffed with newspaper. So the very first thing I'm doing for a wall is stuffing all the nooks and crannies with hemp-lime. I call it hemming up a wall, where I'm attending all the edges and joints carefully. Then, as the whole wall is lifted in hemp-lime, the insulation becomes one monolithic mass.

**CMG:** Many homeowners worry about integrating new materials into old structures. What are the key mistakes to avoid when retrofitting with hemp-lime?

**GK:**
Key thing to know is that, just like wood, hemp-lime can get wet but it cannot stay wet. Avoid hemp-lime connected to ground for that reason. You can absolutely use hemp-lime to insulate a basement floor, but you must provide a vapor break underneath (for example, glavel), as the hemp-lime mass will most certainly wick moisture from ground contact.

For safety's sake, get an education on pH and lime. Always keep vinegar handy for helpers. As additional PPE I recommend coating skin lightly with oil just prior to working with lime.

**CMG:** You're essentially merging 19th-century craftsmanship with 21st-century material science. How do you reconcile preservationist purism—the desire to keep things exactly as they were—with the need for materials that actually help those buildings survive?

**GK:**
Hemp-lime insulation protects and adds structure to forms, thereby extending life—and it naturally looks the part. The beauty in this relationship between old and new is that historic buildings were forever crafted using natural building materials and methods. Historic buildings are natural buildings!

This is an opportunity to rewind the clock on decades of inferior and low-performing building materials. If you've seen horsehair plaster in an old home, it's not hard to imagine hemp-lime with a natural finish plaster. Lime has been used to mortar and plaster homes for ages, and using plants in combination with earth is an ancient practice that is still in use all over the world.

Historic preservation authorities over the years have permitted facades in restoration such as aluminum and asbestos siding. As I lift the interior walls with hemp-lime, I then remove exterior

cladding, revealing the original shiplap. I expect the hemp-lime insulation to mitigate water infiltration for the siding as well as the framing.

It’s a win-win, inside and outside. Hemp-lime insulation restores interiors with historically appropriate plasters, and the material performance permits removal of exterior cladding to reveal and restore original siding.

## Community Impact and Future Models

**CMG:** Ellicott City's historic structures share similar vulnerabilities. Have any of your neighbors or local preservation boards reached out to learn from your approach? What would it take to scale this as a model for flood-resilient retrofits across other heritage districts?

**GK:**
I connected with the Campaign for Historic Trades to discuss integration of hemp-lime insulation and they did respond positively, but no action to date so far as I know. Many possess the knowledge and understanding, but there exist federal funding implications for many organizations like this one.

The hemp-lime insulation in my home was locally funded in part with $5,000 in 2018 flood grant funds from Howard County, Maryland. Earth Tribe Shop on Main Street has engaged an out-of-state architect experienced in hemp-lime construction to recover a structure where Howard County performed a partial demolition.

Like many old towns, Historic Ellicott City was built with a wealth of intention and intelligence. Restoring old buildings with hemp-lime insulation makes it possible for thriving business communities to quickly recover and reopen. When you involve community in building, it can reinforce resilience for generations as knowledge spreads.

## Demonstration, Education, and Future Vision

**CMG:** You referenced training in Ireland with Steve Allin and support from the U.S. Hemp Building Association. How did those international and domestic experiences shape your current vision for outreach or education?

**GK:**
I had the support and guidance of so many already active in hemp building. The USHBA and the people that gathered to form and support it led the way for us all, and the atmosphere has continued to be one of open sharing and collaboration. Virtual meeting spaces like Clubhouse became a powerful way to learn who was up to what in hemp building and farming around the world.

My very first hemp-lime training was with Canadian Chris Magwood in 2019 at a college vo-tech in Asheville, North Carolina. I've since gotten my hands on hemp-lime construction projects in Maryland, Pennsylvania, Florida, and Alabama as well as Alberta, Canada and County Leitrim, Ireland.

I've been mixing with a bell mixer in my basement this whole time, and I started to notice it was frequently stated that the bell is for concrete and is not ideal for hemp-lime. Well listen, I couldn't afford the real McCoy so I kept rolling with my bell mixer because I was making it work just fine. Then I went to Ireland for a stone cottage renovation with Steve Allin. And there across the Atlantic, tucked into the beautiful rolling hills of Eire, was this guru running the whole show from a bell mixer just like mine.

Steve taught us so much about lime properties and showed us how to dress a variety of interior and exterior issues with different lime mixtures. When I trained with Dion LeFebvre of Canada's 8th Fire Innovations in Hawthorne, Florida, we also used a bell mixer and learned to adapt the mix to effectively "mortar" in precast hemp-lime blocks.

**CMG:** In our previous conversation, you mentioned plans to make your home a demonstration site for natural building and flood resilience. What would you like visitors—homeowners, builders, policymakers—to take away from seeing hemp-lime in action?

**GK:**
The key to understanding natural building is experience. I have visitors kick my walls so they will know its strength. People hold back at first—they don't want to hurt my walls. So I show them a solid heel kick and then the real learning begins.

You can really feel a difference in atmosphere, and it only takes feeling to understand. I recently took a yoga class in a renovated space in town and I was reminded I'm too sensitive to be around brand-new off-gassing modern building materials. I think all kinds of indoor activities like yoga can benefit from a healthy hemp-lime atmosphere.

I visited a really beautiful yoga studio in Alberta that Dion with 8th Fire Innovations renovated with hemp-lime blocks and beautifully sculpted wall art. I believe Hempire has built a yoga studio as well. So many are beginning to realize how casting a space with hemp-lime transforms the entire atmosphere—it won't be long before this performance becomes common knowledge.

**CMG:** Looking ahead, what role do you see for hemp-lime in rethinking how Americans build—particularly in historic preservation and sustainability?

**GK:**
Just last October I witnessed how hemp-lime insulation is being used to replace conventional building materials by the Lower Sioux Indian Community in Cansayapi, Minnesota. There's a Patagonia documentary about it called *Green Buffalo* you must see. They're growing industrial hemp, processing it, and using it to improve housing on the reservation.

This is the finest example of American building I can think of, guiding us toward sustainability and preservation.

**CMG:** Finally, what gives you the most confidence, after everything you've lived through, that hemp-lime construction can last "for centuries," as you put it?

**GK:**
I know the 1800s bones of this house are made from incredibly strong, durable timbers. I know the hemp-lime will last just like the wood does. I don't anticipate much in repairs, and I don't expect interior plaster finishes to require resurfacing the way painted drywall does.

Steve Allin is the best guy to follow if you want to deep dive examples of hemp-lime buildings of all ages around the world—I recommend all his books!