23 South Main Street
Hanover, NH 03755
603.643.3300

SEEING THE FOREST AND THE TREES:
How LiDAR Technology Is Transforming Natural Forest Management

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Introduction

For five decades, The Lyme Timber Company has specialized in investing in and managing complex, biodiverse natural forests of North America's timberland asset class. These forests, which span eastern hardwood stands from Maine to Alabama, conifer forests in California and the inland west, and the great mixed forests of the Lakes States, require different management expertise than commercial plantations, and they offer something plantations cannot: resilience, ecological richness, and a range of revenue streams that extend well beyond timber alone.

Managing these forests well has always required "boots-on-the-ground" knowledge. But field expertise, however extensive, has limits when foresters must ground truth thousands of acres. A ridge that appears passable on a topographic map may conceal cliffs. A stream network drawn from decades-old survey data may a significant number of actual waterways on the ground. A stand boundary estimated by walking the land may aggregate what are actually several ecologically distinct communities into a single, imprecisely managed unit.

> *"LiDAR is not simply a better map. It is a fundamentally different way of understanding a forest."*

LiDAR (Light Detection and Ranging) is changing that. Over the past several years, Lyme has integrated airborne LiDAR surveys into our core management practices across our 1.3-million-acre timberland portfolio. The results have been transformative: better environmental protection, lower operating costs, more accurate financial modeling, and stronger pre-acquisition due diligence.

This white paper explains what LiDAR is, how we use it, and why it matters for investors in natural forests.

Our Forests: Why Natural Complexity Requires Specialized Management

Timberland in North America divides broadly into two categories. Core timberlands — southern pine plantations in the US South and Douglas-fir forests in the Pacific Northwest — account for roughly 85–90%

of the asset class by value. These forests are productive, fast-growing, and relatively straightforward to model: one species, uniform ages, predictable harvest rotations of 25 to 30 years.

The Lyme Timber Company focuses almost exclusively on the other category: naturally-regenerating and non-core forests, which represent only 10–15% of the timberland asset class by value but cover a vast geography. Within our eastern US holdings alone, we manage:

- Sugar maple-dominated northern hardwood forests of the Lakes States
- Mixed hard and softwood forests of the Northeast
- Black cherry and red oak stands of the northern Appalachians
- Oak-hickory forests of the southern Appalachians

A single acre of natural forest may host over a dozen tree species across multiple age classes, from seedlings in the understory to 100-year-old canopy dominants. This complexity is precisely what makes these forests so valuable, both ecologically and financially, and why managing them requires a fundamentally different toolkit than plantation forestry.

Natural forests also sit at the heart of North America's most climate-resilient landscapes. Research from The Nature Conservancy identifies the Appalachian corridor, the Lakes States, and the interior West as areas of exceptional ecological connectivity and climate resilience. That resilience translates into tangible financial value through carbon markets, conservation easements, and mitigation banking opportunities that simply do not exist in managed plantations.

But managing this complexity at scale, across landscapes spanning hundreds of thousands of acres and across multiple states and market conditions, requires more information than traditional field surveys can provide. That is where LiDAR enters the picture.

What is LiDAR, and How Do We Use It?

LiDAR data is collected by flying an aircraft over a forest while firing millions of laser pulses per second toward the ground. Each pulse travels through the canopy, reflects off surfaces—leaves, branches, the forest floor—and returns to a sensor on the aircraft. By measuring the precise time each pulse takes to return, the system builds a three-dimensional "point cloud" of the landscape below.

At a density of approximately 20 points per square meter, a LiDAR survey captures a level of structural detail that was simply unavailable at a practical cost just a few years ago. From that point cloud, we derive two primary datasets:

- **Digital Elevation Model (DEM):** The bare-earth terrain beneath the forest canopy, rendered at 5-foot contour intervals. Every slope gradient, stream channel, cliff face, rock outcropping, and subtle bench becomes visible without a single field visit.

- **Canopy Height Model (CHM):** The height, location, and crown size of individual trees across the entire property. Combined with field-verified species data, this enables accurate stand-level timber inventory at a scale and precision previously impossible.

The survey itself costs approximately $1–2 per acre — a one-time investment that, for the complexity of the forests we manage, pays for itself many times over. The data, once collected, supports every phase of the investment lifecycle: pre-acquisition analysis, harvest planning, compliance monitoring, and long-term growth modeling.

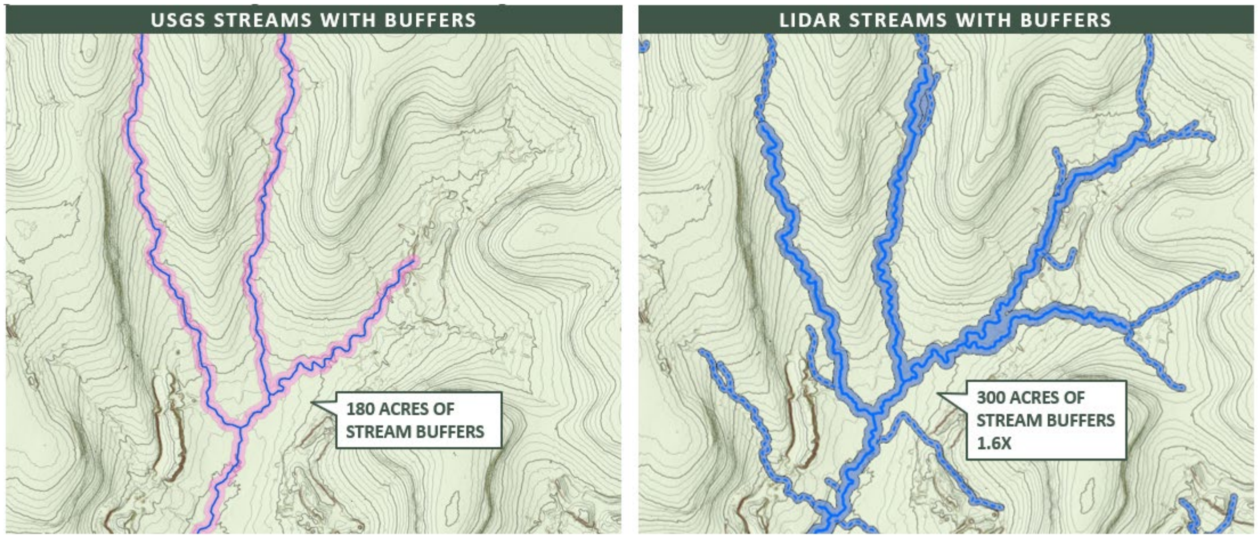
Four Applications That Drive Real Results

1. Stream Network Mapping and Water Protection

Improved stream mapping is one of the most significant immediate benefits of LiDAR. We use the digital elevation model to identify and model water accumulation across stream channels. As illustrated below, the LiDAR informed maps indicate that there are more streams on our properties than traditional maps would reveal. On one of our eastern properties, traditional US Geological Survey (USGS) maps identified 36,900 linear feet of streams. Our LiDAR-derived analysis revealed 81,500 linear feet, more than twice as many.

Why does this matter? State and federal regulations require harvesting buffers around streams to protect water quality, aquatic habitat, and downstream communities. More comprehensive stream mapping helps our forestry teams avoid costly regulatory violations, reduce erosion, cut road maintenance expenses, and avoid damage to high-value riparian timber.

The buffer implications are equally significant. On the same property, USGS-based mapping identified approximately 180 acres of required harvest buffer for a given segment of stream. LiDAR mapping expanded that to roughly 300 acres, which is a 67% increase in protected area. For investors evaluating a potential acquisition, understanding the true extent of no-harvest buffer zones is essential to accurate financial modeling. Overpaying for acres that cannot generate near-term timber revenue is a risk that precise stream data eliminates.



2. Terrain Analysis and Harvest Planning

The LiDAR-based digital elevation model has revolutionized the way we understand terrain and plan timber harvesting. Terrain dramatically affects harvesting costs, equipment selection, and environmental risk. A slope that appears manageable on a traditional 20-foot contour map may include cliffs, boulder fields, or drainage features that render conventional logging impractical or unsafe. LiDAR's 5-foot contour resolution transforms what foresters can see, and therefore plan around, before a single piece of equipment enters the woods.

With detailed terrain data, our foresters can identify old skid trails that can be reused (reducing ground disturbance and cost), locate benches suitable for log staging, route equipment around sensitive soils and steep slopes, and design road networks that minimize erosion and long-term maintenance burden. The result is harvesting that costs less, damages less, and runs more safely.

3. Stand Delineation and Timber Inventory

Historically, we have established stand mapping using aerial imagery or by foresters walking the land and drawing boundaries based on observed conditions. This traditional method of stand delineation inevitably produces generalized management units that average over real variation. For example, within a given area on a property we manage in the Adirondacks of New York, our old stand maps had eight large stands while LiDAR-derived analysis of the same landscape identified more than 40 distinct stands.

This precision matters at every level. More accurate stand boundaries allow foresters to target specific areas for thinning or regeneration rather than applying uniform treatments to heterogeneous conditions. Timber inventory calculated for actual stand conditions, rather than averaged across large units, produces more reliable volume estimates. And more reliable volume estimates translate directly into better financial modeling, more accurate growth and yield projections, and stronger investment performance.

4. Operability Segmentation and Real-Time Compliance

Combining terrain analysis, stream mapping, and stand data, we produce comprehensive operability maps that classify every acre of a property into one of three management zones:

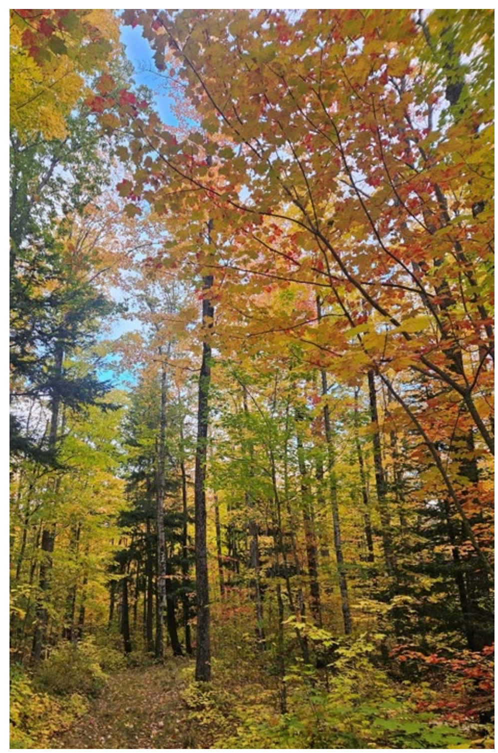
- **Timber Management Areas:** These areas have slopes under 35%, accessible terrain, and are suitable for commercial forestry. These are the acres where intensive management is both economically productive and environmentally appropriate.
- **Ecological Management Areas:** These areas include steeper slopes, wetter conditions, more sensitive soils, and areas where lighter-touch management protects water quality and reduces long-term risk. Selective harvesting may occur here under specific conditions.
- **Reserve Areas:** These areas include streams, wetlands, very steep slopes, and regulatory set-asides protected from commercial harvest.

This segmentation is not simply an environmental exercise. It is a financial discipline. Focusing intensive management on productive, accessible acres and avoiding costly, risky operations in marginal terrain improves returns and reduces liability. It also allows us to better understand the spatial opportunities to promote and protect carbon sequestration, biodiversity, and conservation values that support alternative revenue streams.

The final step is putting this data into the hands of equipment operators in real time. Lyme's logging crews operate with integrated screens displaying LiDAR-derived maps, real-time GPS tracking, and on-screen boundaries. This technology prevents accidental boundary violations, protects streams and buffers precisely, optimizes skid trail routing, reduces fuel costs and equipment wear, and improves logger safety.

What This Means for Investors

LiDAR technology strengthens the investment case for natural timberland at every stage of the investment lifecycle and improves both investment performance and conservation outcomes.



At acquisition: LiDAR analysis reveal the true operable footprint of a property, which prevents overpayment for acres that cannot generate near-term returns and surfaces risks that traditional due diligence cannot identify without extensive (and expensive) field work.

Ongoing management: access to LiDAR-derived data reduces field labor requirements, improves harvest efficiency, and lowers compliance risk. More accurate stand inventories and operability mapping also supports more reliable harvest scheduling and long-term financial modeling. This also helps improve conservation outcomes and identify opportunities to monetize conservation values through conservation sales and ecosystem services markets.

Investment Outcomes	Conservation Outcomes
Better underwriting through pre-acquisition analysis	Accurate stream network mapping—2.2x more streams identified than traditional methods
Full visibility into operability constraints and legal buffers	Expanded riparian buffers (up to 1.6x more protected area)
Lower management costs via optimized road design and harvest planning	Precise habitat identification for threatened species and old-growth reserves
Improved timber inventory accuracy for financial modeling	Reduced erosion and soil disturbance through better equipment routing
Real-time GPS compliance tracking to prevent boundary violations	Enhanced carbon sequestration through adaptive, data-driven management

Conclusion

For decades, managing complex natural forests required an enormous amount of expensive field work and still left significant knowledge gaps. While LiDAR does not eliminate the need for local expertise and experienced field foresters or the relationships we have built with local logging crews and communities and field work, it is closing that gap and providing a critical tool to help us understand and model large-scale timberland properties with more precision than was previously possible.

By incorporating LiDAR into the core of how we analyze, plan, and manage our forests, we can simultaneously achieve financial and environmentally goals: protecting more streams, identifying more habitat, reducing more erosion, and improving returns for our investors.

For more information about The Lyme Timber Company and our investment approach, please contact us at investorrelations@lymetimber.com | ***www.lymetimber.com***