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**Green Marine Products**

FINAL REPORT  
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Submitted by

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In cooperation with

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16. Abstract The purpose of this project was to comprehensively assess the sustainability of a selection of common products and materials for marine applications. The primary goal was to provide marina owners and patrons who wish to operate more sustainably with a supplemental, objective resource for making informed purchasing decisions. Each product or material was evaluated against five key sustainability attributes covering initial material harvesting/extraction to manufacture/processing, shipping and delivery, installation, and final disposal.					
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## EXECUTIVE SUMMARY

The purpose of this project was to comprehensively assess the sustainability of a selection of commonly used products and materials for marine applications. The primary goal was to provide marina owners and patrons who wish to operate more sustainably with a supplemental, objective resource for making informed purchasing decisions. Each product or material was evaluated against five key sustainability attributes covering everything from initial material harvesting/extraction to manufacture/processing, shipping and delivery, installation, and final disposal. The results for each product or material are reported in appendix B.

The Research team undertook this project in three steps:

1. Identified marine products and materials for assessment, as well as informational sources.
2. Generated potential sustainability attributes—attributes which together are sufficient to encompass the broad concept of sustainability.
3. Applied the sustainability attributes to the selected products and materials in order to generate qualitative sustainability reports for each.

The third step involved a qualitative assessment of 39 selected products and materials against the predefined sustainability attributes. Each product was evaluated against the entire list of sustainability sub-attributes using a simple rating of positive, neutral or negative. Where reliable information was unavailable no rating was assigned. The Green Marine Product Reports are included in appendix B.

Comprehensive sustainability information for marine products and materials can be challenging to obtain. Manufacturers may be motivated to emphasize areas of positive environmental performance, but have little incentive to highlight negative aspects. Few products claimed any form of third-party sustainability certification. Manufacturer materials (with the exception of Material Data Safety Sheets) were often too vague to permit a comprehensive review against all five sustainability attribute categories.

Despite these limitations, this research report provides a valuable informational resource for marina owners and patrons. The report provides a solid basis for considering the sustainability of many products and materials—in addition to identifying open questions that concerned users can address directly with manufacturers or distributors. The sustainability attributes and framework developed here can be used for any product or material, whether formally or informally. It is hoped that these tools will serve to prioritize the importance of sustainability for future procurements of marine products and materials throughout the State of New Jersey.

## **INTRODUCTION**

The purpose of this project was to comprehensively assess the sustainability of a selection of commonly used products and materials for marine applications. The primary goal was to provide marina owners and patrons who wish to operate more sustainably with an objective resource for making informed purchasing decisions. Each product or material was evaluated against five key sustainability attributes covering everything from initial material harvesting/extraction to manufacture/processing, shipping and delivery, installation, and final disposal. The results for each product or material are reported in appendix B.

The product reports produced by this research are not an endorsement of any product or product type. Assessment of the quality, performance, and suitability of products for specific applications was beyond the scope of this report, with the assumption being that marina owners and boaters, as direct product users, are better positioned to determine what products to consider for various applications. Cost and cost effectiveness are also left to the direct user, as prices vary depending on the retailer/wholesaler/manufacturer, fluctuate over time, and may differ for customers based upon size of the order, application, or negotiation. However, contact information for manufacturers and distributors is provided in order to facilitate direct inquiries should readers of this report require further information or clarifications.

## **APPROACH AND METHODOLOGY**

The Research team undertook this project in three steps:

- Identified marine products and materials for assessment, as well as informational sources.
- Generated potential sustainability attributes—attributes which together are sufficient to encompass the broad concept of sustainability.
- Applied the sustainability attributes to the selected products and materials in order to generate qualitative sustainability reports for each..

### **Identify Marine Products**

With input from the New Jersey Department of Transportation (NJDOT), the research team compiled a listing of commonly used marine products and materials from marina supply catalogs, marina industry publications, and internet research. The product types chosen for assessment include materials for marina, dock, pier, and slip construction; materials for shoreline treatments (bulkheads, for example); upland paving materials; and selected products for boat maintenance and repair.

Each product category was, where appropriate, further divided into major subcategories. Although several products are often available within each product category and subcategory, only a few could realistically be evaluated within the scope of this project. For products without significant differentiation, a representative product

was assessed. For more complex product categories with a wide variety of examples, a leading or local product was selected. Relevant products advertised as being “sustainable,” “green,” or “eco-friendly” by their manufacturers are also assessed. A complete list of product categories and subcategories is presented in table 1.

Table 1 - Green Marine Product Categories and Products

Application	Product Category	Material or Product
Marine Structures	Pilings	Tropical Wood
		Treated Wood
		Concrete
		Fiberglass Composite
		Fiber Reinforced Polymer
		Pile Wraps/Coatings
		Pile Restorer
	Fenders, bumpers, rubrails	Vinyl
	Decking for piers & gangways	Wood
		Polypropylene
		Polyethylene
		Aluminum
		Concrete
	Floating docks	Polyethylene
	Bulkheads/Seawalls	Fiber Reinforced Polymer
		Fiberglass Composite
		Vinyl
		Composite Sheet Piling
		Polymer-coated wood

Application	Product Category	Material or Product
	Solar dock lighting and stanchions	Polyethylene & silicon
Upland	Parking areas	Porous surfaces
Vessel Maintenance & Repair	Fueling	Fuel spill guard systems
	Cleaning Products	Boat wash
		Degreaser
		Marine growth remover
Vessel repair	Paint stripper	

**Define Sustainability Attributes**

While there are several well-known certification systems for green products and practices, there is no universal standard for assessing product sustainability in the marine context. In an effort to consider sustainability from a broad, multifaceted perspective, the attributes were drawn primarily from existing certification systems—such as Green Seal and Leadership in Energy and Environmental Design (LEED)—and then adapted to the marine context. A complete listing of literature and certification systems that served as guidelines for defining sustainability attributes in this exercise is attached to this document as **Appendix A: Sustainability Attributes Bibliography**.

The following five sustainability attributes were identified, and a working definition was developed for each:

- **Harvesting and Extraction:** The harvesting or extraction of natural materials significant in the composition of the product. Harvesting includes the removal of materials from forests, fields, or other cultivated or non-cultivated natural resources. Extraction includes the removal of otherwise inaccessible materials through mining, drilling, blasting or other invasive processes.
- **Processing:** The process(es) employed to assemble, manufacture, compose, treat, form, or otherwise prepare a product for use in the marine context.
- **Delivery/shipment:** The transportation of materials/product components from the site of harvesting/extraction to the processing facility and then to New Jersey.
- **Installation and Utilization:** The process of installing the product, including site preparation, use of installation equipment, and the actual act of attaching or placing the product, and/or the impacts attributed to normal product utilization.



- **Lifecycle:** The impacts relating to standard product maintenance, product degradation over time, and end-of-life product disposal.

These attributes were further divided in order to facilitate a more nuanced assessment, and to provide protocols for evaluating the ecological sustainability of each product. Following are the 17 evaluation criteria, which are each paired with more detailed guidance for determining whether a specific product is considered to be positive (☑), neutral (☐), or negative (☒) in relation to the corresponding sustainability attribute.

### **Harvesting and Extraction**

#### 1. Energy and emissions:

- ☑ Harvesting/extraction requires minimal exogenous energy and/or utilizes low-emitting fuel sources. Examples: Use of recycled/reclaimed materials, manually harvested materials, bio-diesel or CNG-powered machinery.
- ☐ Harvesting/extraction requires moderate energy consumption and/or produces moderate emissions. Examples: Standard farm equipment, logging rigs, construction vehicles.
- ☒ Harvesting/extraction requires significant exogenous energy and/or produces significant emissions. Examples: Blasting, unmitigated mining or drilling, heavy vehicles and equipment.

#### 2. Destruction of carbon sinks:

- ☑ Materials playing a significant role in holding carbon are not disturbed or are rapidly replenished. Examples: No destruction of slow growth trees or widespread disturbance of soil carbon.
- ☐ Some destruction or disturbance of carbon holding materials occurs (or, on par with like products). Examples: Tropical hardwood harvesting is sustainably managed (Forest Stewardship Council (FSC) certified).
- ☒ Significant and/or long-term destruction of important carbon sinks. Examples: Tropical hardwoods are destroyed without sustainable management practices, clear cutting.

### 3. Term of resource renewal:

- ① Resource is recycled/reclaimed, superabundant, or regenerates in weeks, months, or a few years. Examples: Agri-fibers, bamboo, most steel products, bioplastics, some aggregates.
- ② Slow growth, but harvesting is small scale or managed; or, resource is currently abundant but ultimately limited. Examples: Small scale logging operations, petroleum-based products (plastics), rubber.
- ③ Resource is very slow growing (not managed) or is rare and irreplaceable. Examples: Tropical hardwoods, rare metals/minerals.

### 4. Impact on affected populations:

- ① Minimal disruption of inhabited areas or local resources, citizen participation, job opportunities. Examples: Cooperative agri-products, recycling/reclamation, managed timber, substantial local employment.
- ② Moderate disruption of inhabited areas or local resources, some citizen participation and job opportunities. Examples: Noise and/or dust impacts near populations, use of traditionally agricultural lands, low wages.
- ③ Major disruption of inhabited areas or local resources, poor citizen participation and job opportunities. Examples: Toxic releases near populations, destruction of cultural or religious resources, unsafe work areas.

### 5. Destruction of habitat:

- ① Harvesting/extraction has negligible impacts on habitat. Examples: Recycling, small-scale managed harvesting.
- ② Harvesting/extraction has noticeable, but not severe or permanent impacts on habitat. Examples: Some non-toxic extractions, selective logging.
- ③ Harvesting/extraction has severe and/or permanent negative impacts on habitat. Examples: Unmitigated blasting, mining or drilling, clear cutting.

## Processing

### 6. Energy and emissions:

- ① Processing requires minimal exogenous energy and/or utilizes low-emitting treatments. Examples: Wood requiring minimal treatment and processing, reclaimed materials.
- ② Processing requires moderate energy consumption and/or produces moderate emissions. Examples: Recycled plastics, processed wood products, vinyl.
- ③ Processing requires significant exogenous energy and/or produces significant emissions. Examples: Concrete, metals requiring extensive smelting (steel).

### 7. Waste streams:

- ① Processing produces minimal non-recycled/reclaimed byproducts. Examples: Wood pilings, plastics with recycled tailings/scrap.
- ② Processing produces moderate non-recycled/reclaimed byproducts. Examples: Vinyl or plastics without scrap/tailing reclamation.
- ③ Processing produces significant non-recycled/reclaimed byproducts. Examples: Most steels (slag products of 300-500 kg/t of steel).

### 8. Working conditions:

- ① High labor standards, workplace safety standards, and wages. Examples: Unionized labor in developed nations, worker cooperatives in developing nations.
- ② Acceptable labor standards, workplace safety standards, and wages. Examples: Non-unionized labor in most developed nations, skilled labor in developing nations.
- ③ Poor labor standards, workplace safety standards, and wages. Examples: Unskilled labor in many developing nations.

## **Delivery/Shipment**

### 9. Energy and emissions:

- ① Product (or components) travel short distances or utilize efficient modes/fuels. Examples: New Jersey products, or regional products transported in quantity by rail or ferry.
- ② Product (or components) travel moderate distances or utilize moderately efficient modes/fuels. Examples: Products transported by rail or ship (with minimal surface transportation).
- ③ Product (or components) travel significant distances or utilize less efficient modes/fuels. Examples: Logs trucked across the US, bulky air freight.

### 10. Packaging:

- ① Product requires negligible packaging or packaging is reused, reclaimed, recycled or biodegradable. Examples: Pilings transported in bulk, liquid or bulk products pumped from tank to tank.
- ② Product requires moderate packaging or packaging may be reused, reclaimed, recycled or biodegradable. Examples: Products in shrink wrapping or cardboard boxes.
- ③ Product requires significant packaging and is not reused, reclaimed, recycled or biodegradable. Examples: Products requiring Styrofoam blocks or unrecyclable plastics.

## **Installation and Utilization**

### 11. Energy and emissions:

- ① Installation and/or utilization requires minimal energy and yields few emissions. Examples: Products installed by hand or with light equipment, no exogenous power required for utilization.
- ② Installation and/or utilization requires moderate energy and/or yields moderate emissions. Examples: Products requiring construction machinery or that require utility power.
- ③ Installation and/or utilization requires significant energy and/or yields significant emissions. Examples: Heavy pile driving, major earth moving, blasting, or drilling.

## 12. Toxicity of co-products:

- ① Requires no co-products or co-products are inert. Examples: Tropical hardwood pilings.
- ② Requires co-products that may cause minor environmental impacts. Examples: Woods requiring standard waterproofing, borer protection, or adhesives.
- ③ Requires co-products that may cause significant environmental impacts. Examples: Co-products containing mercury, lead, arsenic, CCA, or other known toxins.

## 13. Habitat/ecosystem impacts:

- ① Installation/utilization has minimal and temporary impacts on habitat and ecosystems. Examples: Non-toxic cleaning or degreasing products.
- ② Installation/utilization has moderate and lasting impacts on habitat and ecosystems. Examples: Floating docks, rip rap, decking.
- ③ Installation/utilization has significant and permanent impacts on habitat and ecosystems. Examples: Bulkheads, products requiring heavy dredging, drilling, driving, or blasting.

## **Lifecycle**

### 14. Lifespan (Warranty):

- ① Substantial lifespan/warranty compared to resource value or other products in its class. Examples: Tropical hardwood pilings, rip rap.
- ② Adequate lifespan/warranty compared to resource value or other products in its class. Examples: Standard pilings, bulkheads.
- ③ Poor lifespan/warranty compared to resource value or other products in its class. Examples: Photo-sensitive plastic products, untreated concrete sub-surface products.

### 15. Maintenance:

- ① Requires negligible maintenance and upkeep (or low impact, low energy maintenance). Examples: Rip rap, borer resistant pilings.
- ② Requires moderate impact and energy maintenance. Examples: Decking, paving, bulkheads.
- ③ Requires significant, energy intensive maintenance. Examples: Dock and shore power pedestals.

#### 16. Toxic degradation:

- ① Product does not degrade or is entirely organic. Examples: Untreated pilings, rip rap.
- ② Product leaches or deposits mildly toxic materials as it degrades. Examples: Bulkheads, concrete.
- ③ Product leaches or deposits significantly toxic materials as it degrades. Examples: Woods treated with toxic co-products.

#### 17. Disposal:

- ① Product is organic, is fully recycled, or otherwise reclaimed. Examples: Untreated woods, rip rap, materials with guaranteed manufacturer recycling.
- ② Product requires standard landfilling or managed disposal. Examples: Polyethylene pile wraps, vinyl products.
- ③ Product is classified as a hazardous material upon removal, requires special disposal. Examples: Products containing heavy metals or known toxins.

### **Green Marine Product Evaluation Reports**

The final step of the research involved a qualitative assessment of 39 selected products and materials against the predefined sustainability attributes. Each product was evaluated against the entire list of sustainability sub-attributes using a simple rating of positive, neutral and negative. Where reliable information was unavailable, no rating was assigned. A one-page Green Marine Product Evaluation Report is available for each item reviewed in appendix B.

## **CONCLUSIONS and RECOMMENDATIONS**

Comprehensive sustainability information for marine products and materials can be challenging to obtain. Manufacturers may be motivated to emphasize areas of positive environmental performance, but have little incentive to highlight negative aspects. Few products claimed any form of third-party sustainability certification. Manufacturer materials (with the exception of Material Data Safety Sheets) were often too vague to permit a comprehensive review against all five categories.

For many products a full assessment proved difficult or impossible. Several product reports have more blanks than ratings, demonstrating the need for more transparency from manufacturers throughout the product lifecycle. A far more significant research effort would be required to identify the precise materials, sources, production practices, shipping specifications, and disposal practices for each of the products reviewed in this study, and hundreds of other products available on the market. Such an effort may be beyond the reach of NJDOT, although a consortium of state DOT marine resource groups or of marina users themselves could be better positioned to provide the resources for such an effort. This report would provide a good base for future research.

Although this report does not endorse any product or product type, it provides a valuable informational resource for marina owners and patrons. Notwithstanding the informational gaps, the material summaries provide a solid basis for considering the sustainability of many products and materials, in addition to providing open questions, in the form of blank cells, for concerned users to address directly with manufacturers or distributors.

The sustainability attributes and framework developed here can be used for any product or material, whether formally or informally. It is hoped that these tools will serve to prioritize the importance of sustainability for future procurements of marine products and materials throughout the State of New Jersey. Dissemination of this information to the boating community could be handled through NJDOT, the I-Boat-NJ website, as supplemental guidelines for marina operators in NJDEP's Clean Marinas program, and through other appropriate outlets.