THRUFLOW™
Interlocking Panels

Product Handbook

What Makes ThruFlow™ better?

Benefits of ThruFlow Decking

Storm Resistant

- minimizes the effects of uplift on decking surface from wind or water (Storm Surge).
- Docks with ThruFlow have weathered several hurricanes in the Florida Keys and ALL other docks were destroyed.

Safe

- The 360 Degree non-slip surface is unique, comfortable and extremely effective. Coefficient of Slip 0.78
- Water will not sit on the surface
- Americans with disabilities act compliant

Maintenance Free

- Stays clean without any special or expensive cleaning products
- No Staining
- No painting
- No sealing
- No Warping
- No Splinters

Easy to Install

- Interlocking tabs insure alignment
- Light Weight. Easy to carry to installation
- Saves Labour, use 1/2 the screws = less labour time in completing your project. Do more projects with the same resources or simply have less labour cost.
- Available in 36" (915mm), 48" (1220mm) and 60" (1525mm) Lengths

Environmentally Friendly

- Allows Water and/or Light to penetrate minimizing the effect of the walking surface on the indigenous plants and animals
- Will not leach anything into the environment
- Army Corps or Engineers approved over sea grass and mangrove habitat.

Durable

- Impervious to Rot
- Impervious to Insects
- Colour Fast
- Excellent Warranty
- Will not absorb water
- Strong - Excellent load bearing capability
- UV Stabilizing Additive
- Anti-Static Additive

Attractive

- Clean lines and timeless design lend an attractiveness to the product that will last.

Stays Cool

- Grated design and light colours combine to limit any retention of heat in the product.

Foot Friendly

- Massages bare feet with unique non-slip surface

Project & Application Gallery


Vogell Marine Inc.
V.I.P Associates
"The Quality Marine Team"
Southern Pine
LUMBER
Co.
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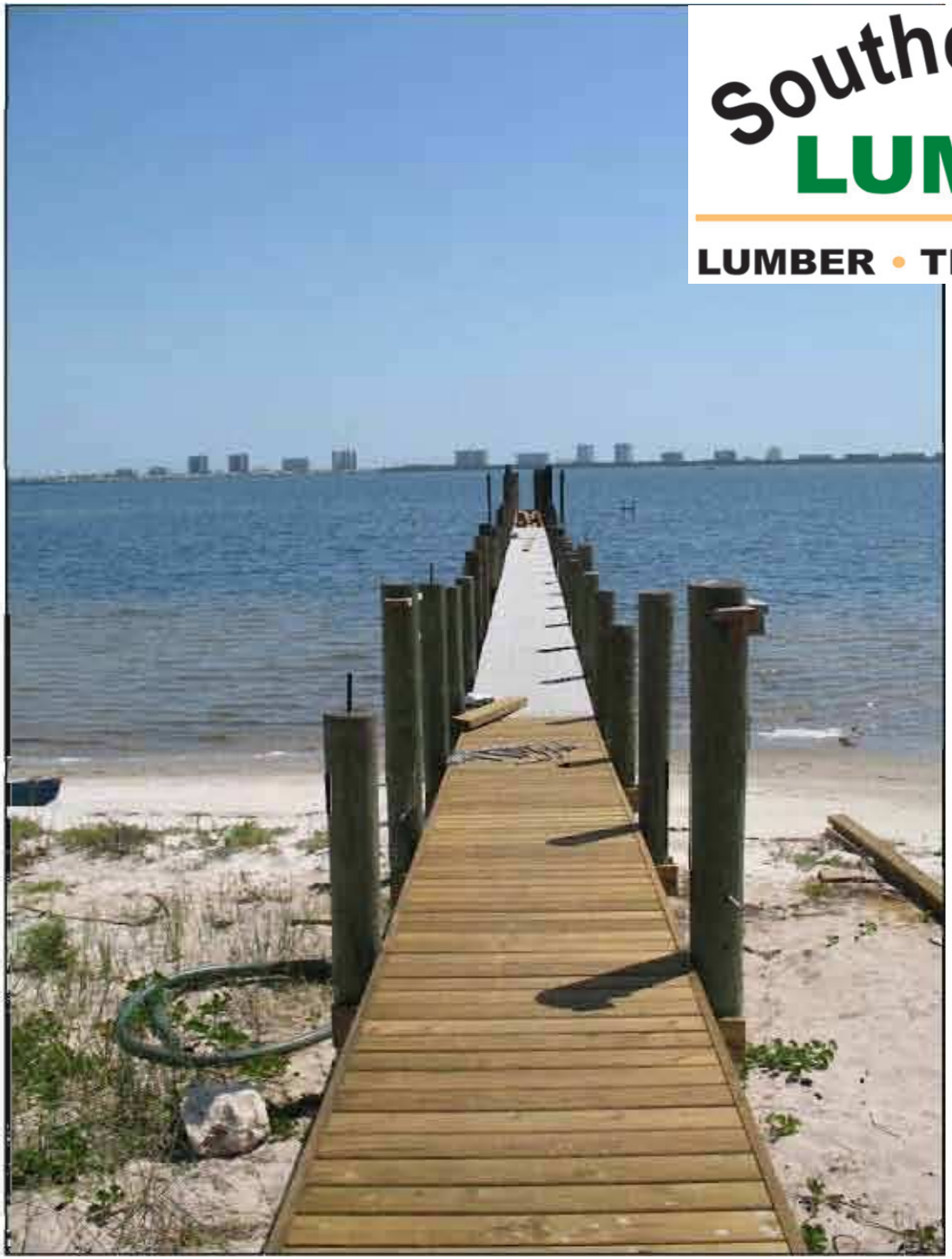

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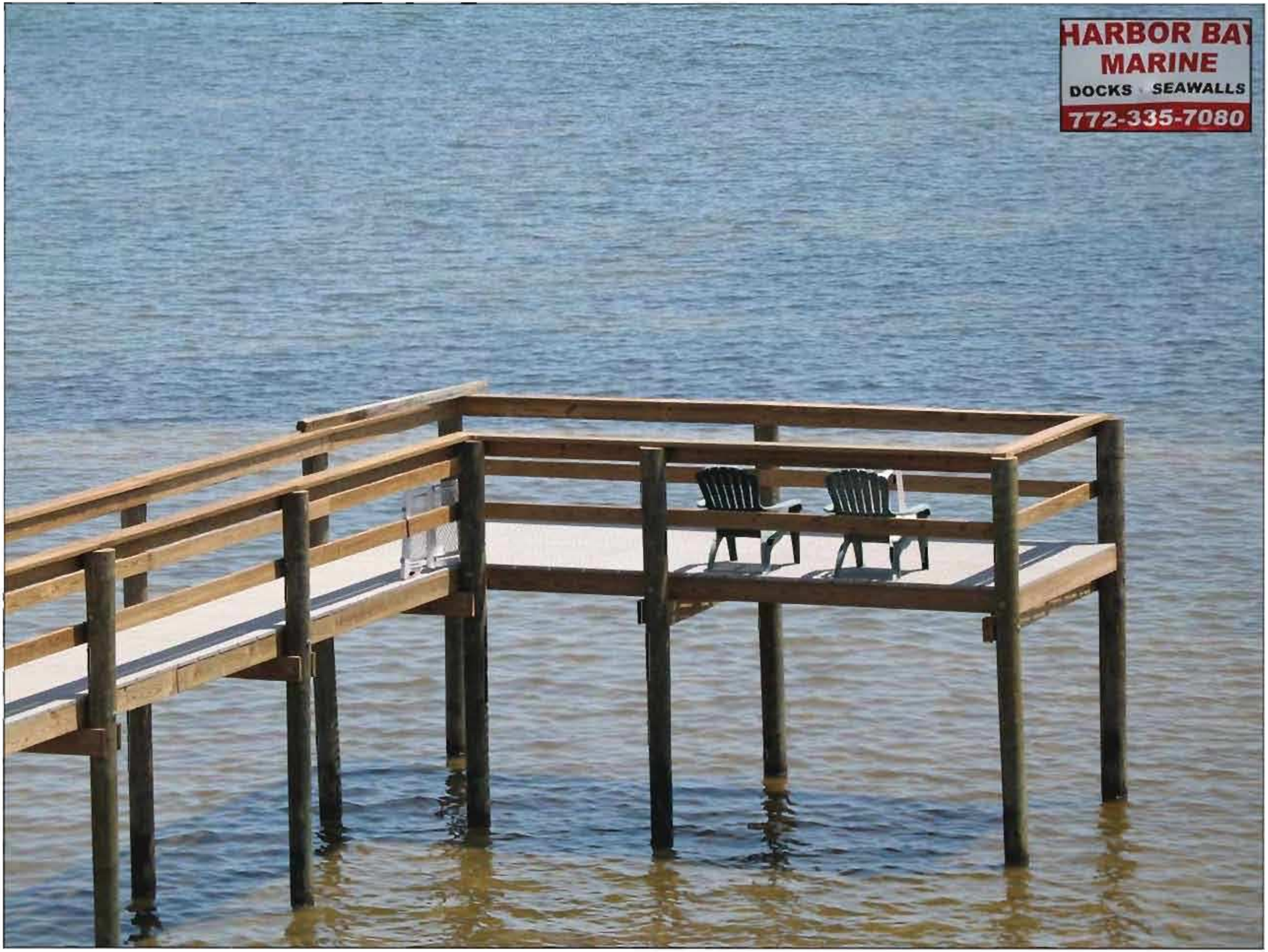
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STEMIC
MARINE CONSTRUCTION


GRATING PACIFIC

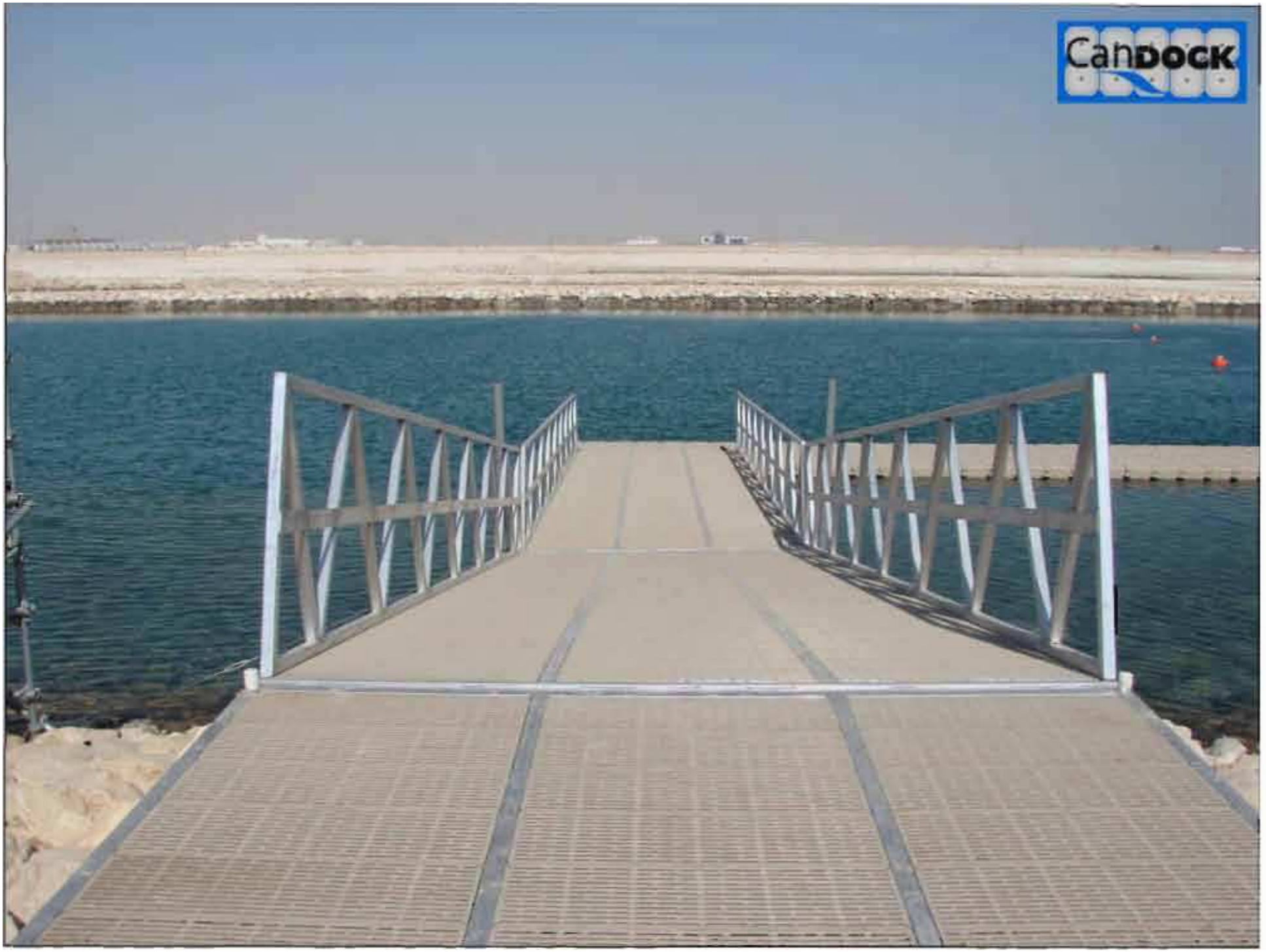
ARRK

Arrk Australia & New Zealand Pty


I Innovative
P Products
M Marketing


GRATING PACIFIC


NEWMANS


CanDOCK


Riverside
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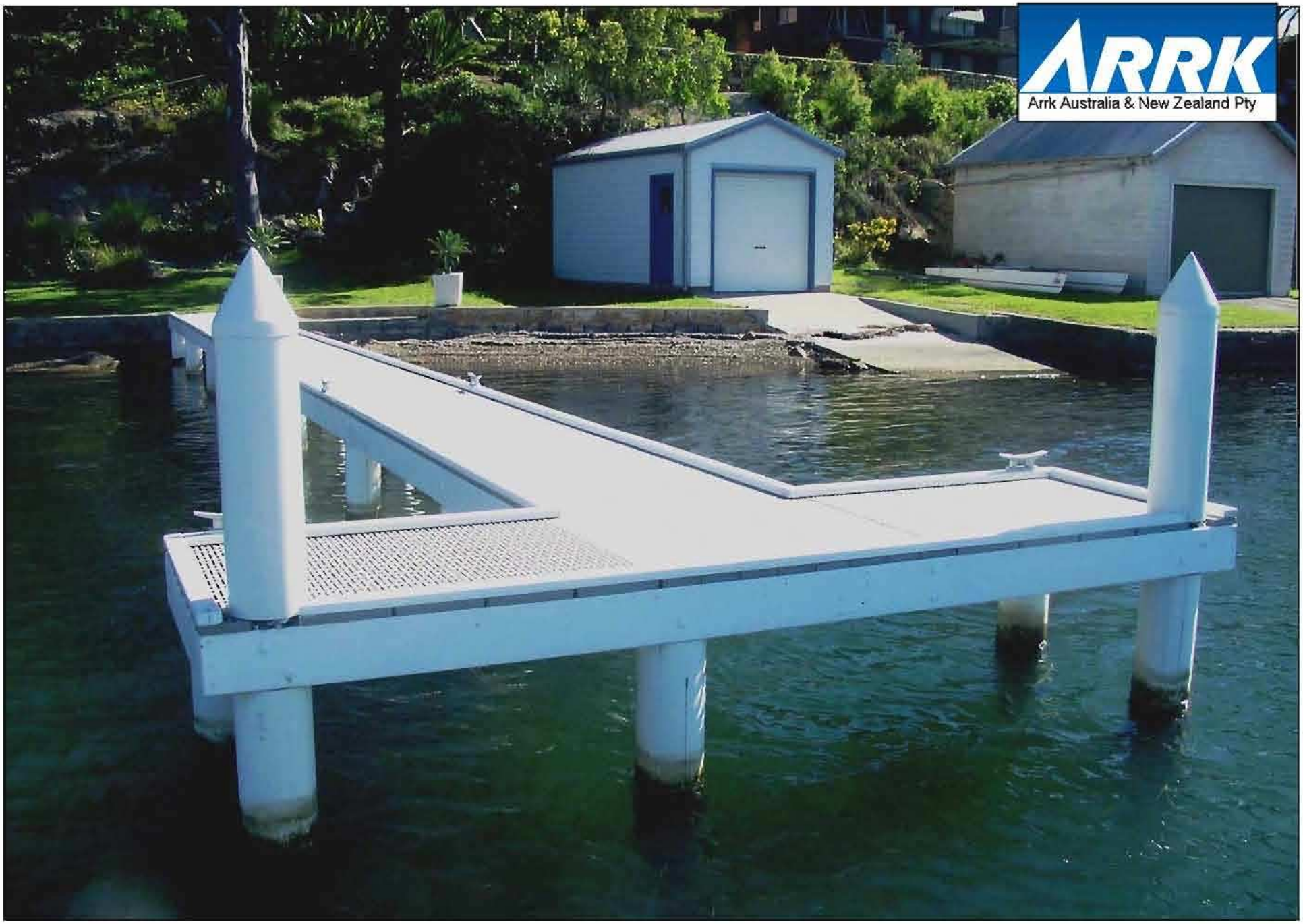
THRUFLOW
Interlocking Panels


THRUFLOW
Interlocking Panels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Northeast Docks, Inc.


THRUFLOW
Interlocking Panels


NEWMANS


NEWMANS


NEWMANS


NEWMANS


THRUFLOW
Interlocking Panels


EZ roll


FWM
DOCKS


THRUFLOW
Interlocking Panels


THRUFLOW
Interlocking Panels


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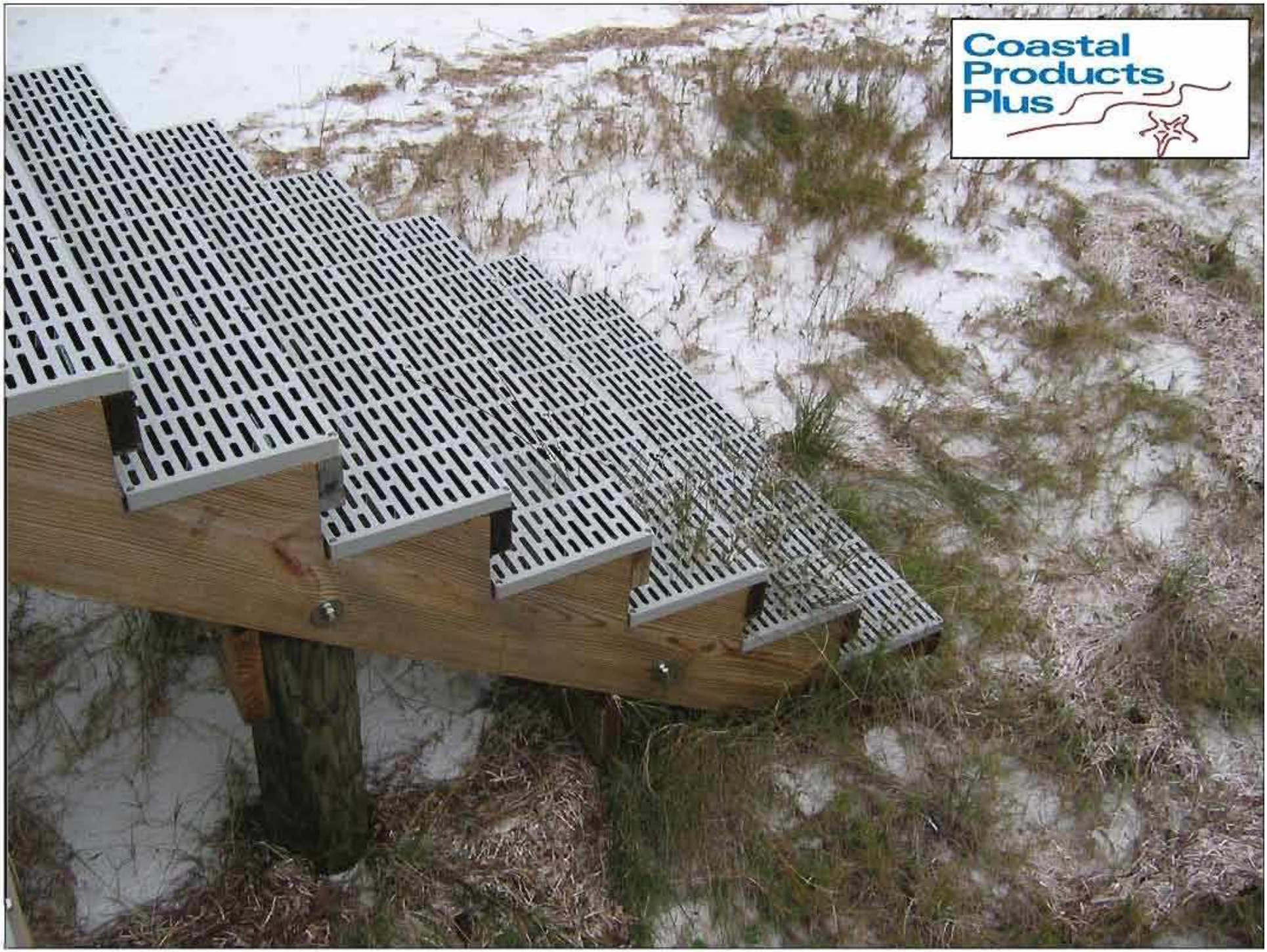
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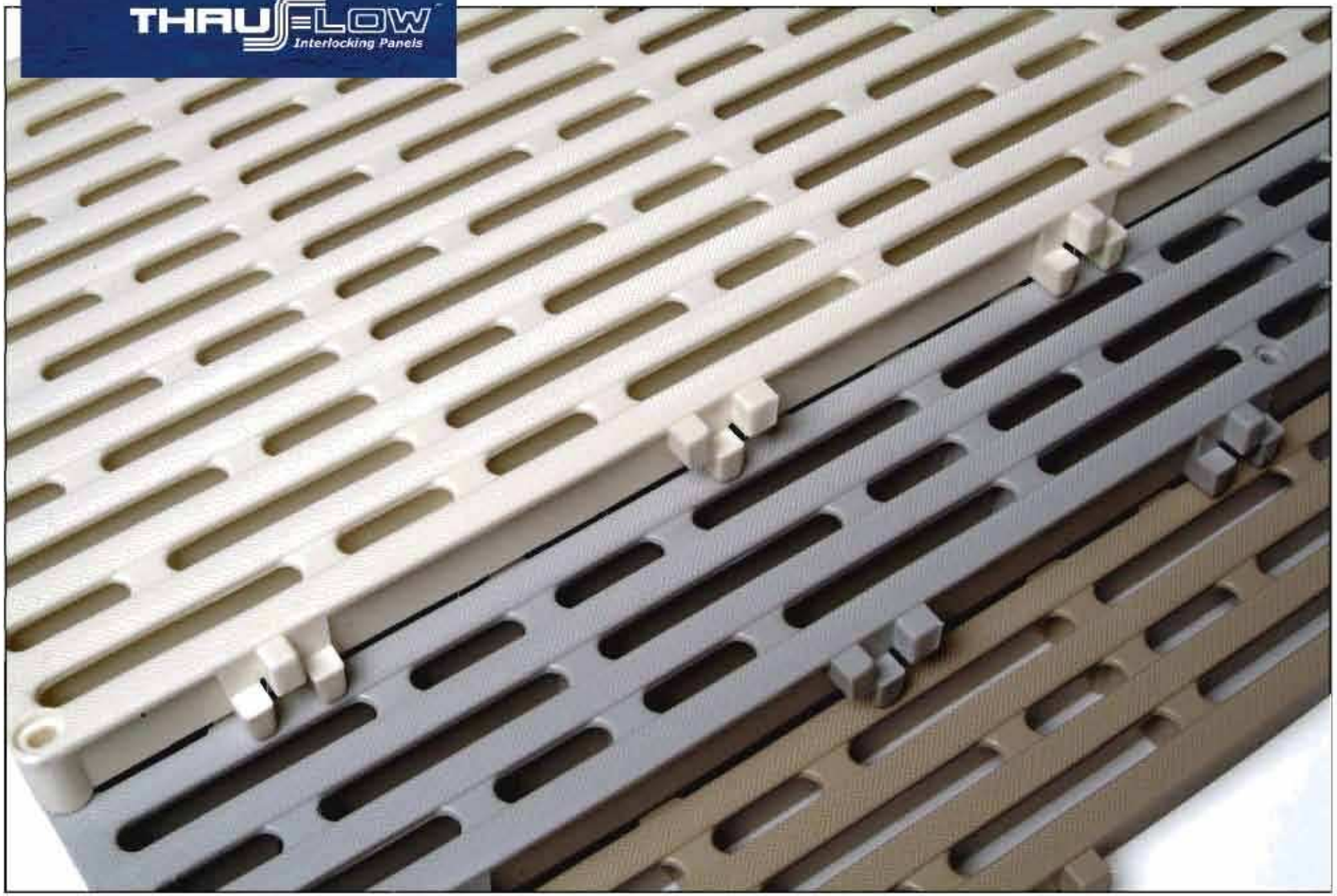
THAUFLOW
Interlocking Panels




THRUFLOW
Interlocking Panels

Advertisements

THRUFLOW™

Let sunlight reach those sensitive areas

ThruFlow's ability to allow sunlight to penetrate to environmentally sensitive areas, makes this product an excellent alternative to traditional decks, docks, or walkways.

Features include:

- Limited Warranty
- Full UV and Anti-Static Protection
- Easy to Assemble
- Stays Cool to the Touch
- Excellent Load Bearing Capability
- 360° Non-Slip Surface
- Lightweight

For more information, please visit us online at **www.thruflow.com** or call **1-888-478-3569**

Will the next dock you build make it...

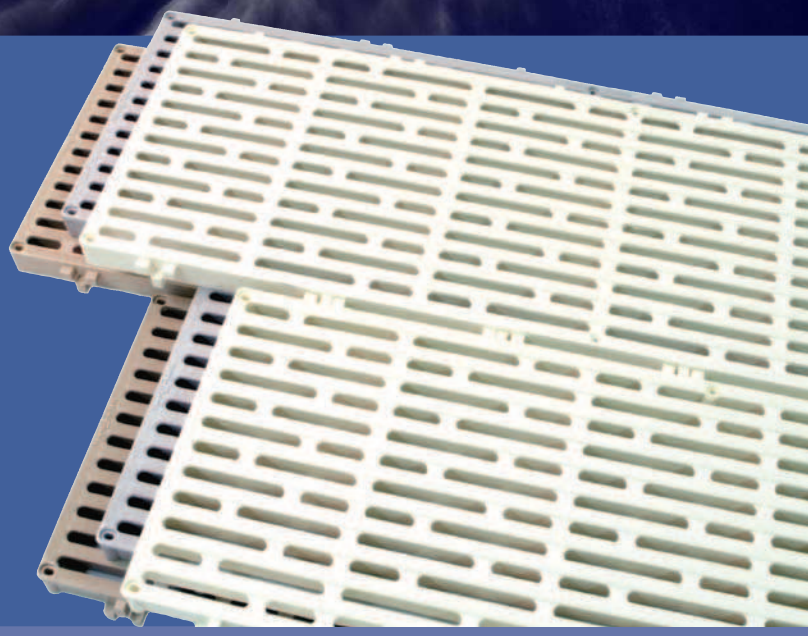
THRU THE STORM?

ThruFlow™ interlocking deck panels are grated; this helps to prevent damage from uplift in Hurricanes and Storm Surge!

ThruFlow™ offers many benefits to the marine contractor and your customers!

www.thruflow.com

- Allows Sunlight, Water and Debris Through
- Easy to Assemble
- 360 Degree Non-Slip Surface
- No Fabrication
- Environmentally Friendly
- ADA Compliant
- Available in 3' x 1', 4'x1' and 5'x1' Panels
- Superior Load Bearing Capability
- Strong, Durable and Lightweight
- Helps Minimize Storm Surge and Wave Effects
- No Maintenance
- Interlocking Tabs for Easy Installation
- ACOE Approved Over Seagrass



THRUFLOW™
Interlocking Panels

To find out more visit www.thruflow.com or call
1-88-THRUFLOW (1-888-478-3569) for more information.

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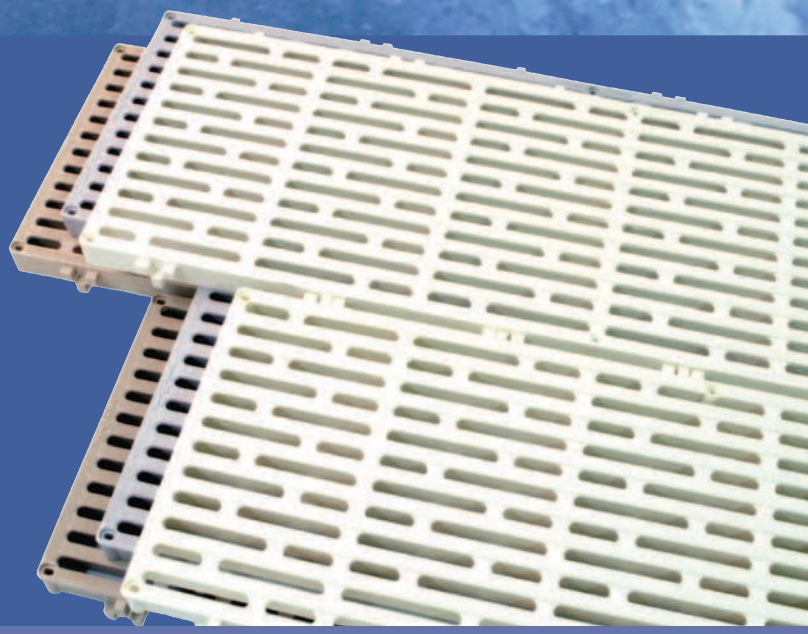


THRUFLOW™
Interlocking Panels

To find out more visit www.thruflow.com or call 1-88-THRUFLOW (1-888-478-3569) for more information.

Let the Sunshine THRU

Complete flooring system for Docks, Decks, Patios & Walkways!

ThruFlow's ability to allow sunlight to penetrate to underlying natural habitats, and other environmentally sensitive areas, makes this product an excellent alternative to traditional decks, docks or walkways.

Easy to assemble and with no maintenance required, ThruFlow is designed to be the finished surface for a dock or any indoor or outdoor flooring structure. ThruFlow offers a true, maintenance free, non-slip finished surface that stays cool to the touch. Its interlocking panel system ensures easy assembly, and the panel openings allow water, sunlight, and debris to pass through easily.

For more information, please visit us online at **www.thruflow.com** or call **1-888-478-3569.**

THRUFLOW™

Strong, Durable, Protected

THRUFLOW™

ThruFlow's ability to allow sunlight to penetrate to environmentally sensitive areas, makes this product an excellent alternative to traditional decks, docks, or walkways.

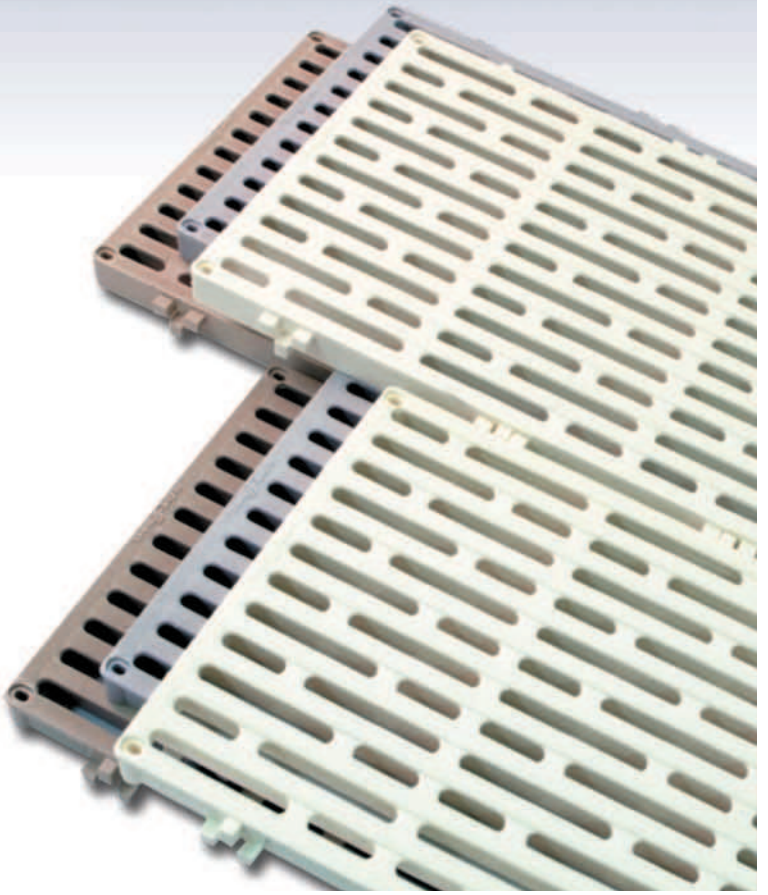
Strength: Excellent Load Bearing Capability

Durability: Full Coverage Limited Warranty

Protection: Full UV and Anti-Static Protection

Other Advantages Include:

- Easy to Assemble
- 360º Non-Slip Surface
- Lightweight
- Stays Cool to the Touch

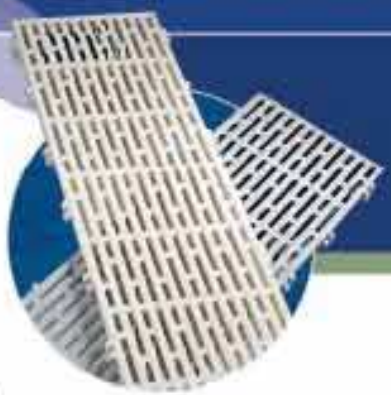


Visit **www.thruflow.com** or call **1-888-478-3569** for more information.

"**WOW** the new place is great.
I love the sky lights."

Let sunlight reach those sensitive areas.

ThruFlow™ Interlocking Panels offer a number of advantages to traditional decking for docks, decks, patios and walkways.



- Allows Sunlight, Water and Debris Through
- Easy to Assemble
- 360 Degree Non-Slip Surface
- No Fabrication
- Environmentally Friendly
- ADA Compliant
- Available in 3' x 1', 4' x 1' and 5' x 1' Panels
- Superior Load Bearing Capability
- Strong, Durable and Lightweight
- Helps Minimize Storm Surge and Wave Effects
- No Maintenance
- Interlocking Tabs for Easy Installation
- ACOE Approved Over Seagrass

With so many applications and product advantages, **ThruFlow™** panels truly are the complete flooring system for virtually any indoor or outdoor structure.

Decks

Docks

Attic Storage & Access

Walkways

To find out more visit **www.thruflow.com** or call **1-888-THRUFLOW (1-888-478-3569)** for more information.

THRUFLOW™
Interlocking Panels

Brochure

THRU-FLOW

Interlocking Panels

The complete
decking system for

**DOCKS, DECKS,
PATIOS, WALKWAYS.**

Virtually any indoor or
outdoor application!

ThruFlow™ is a finished decking system designed for easy assembly that requires no maintenance. It's ideal for walkways, docks, or any outdoor flooring structure.

ThruFlow's™ design minimizes storm damage from wind and surge effects, as well as helps to protect marine life by allowing light to penetrate waterways.

APPLICATIONS

ThruFlow™ is designed to be the finished walkway for a dock, deck, patio, or any indoor or outdoor flooring structure, or to increase usable space in the home. It is designed to use in conjunction with metal, wood, aluminum or other similar substructures.

ADVANTAGES

The ThruFlow™ decking system offers a number of advantages over traditional decking. ThruFlow™ is a ***STRONG, DURABLE*** and ***LIGHTWEIGHT*** application for patios, decks, walkways, and docks.

- » No Maintenance
- » UV and Static Electricity Protection
- » Superior Load Bearing Capability
- » 360 Degree Non-Slip Surface
- » Strong, Durable and Lightweight
- » Available in 3, 4 and 5 foot lengths
- » Pre-Drilled and Countersunk for Easy Installation
- » Allows Sunlight, Water and Debris Through
- » Helps Minimize Storm Surge and Wave Effects
- » Stays Cool Even in the Hot Summer Sun
- » ACOE Approved
- » ADA Compliant

The ThruFlow™ interlocking decking system is ideal for docks, due to it's water resistance and anti-slip surface. ThruFlow's™ sunlight and water penetration helps keep vegetation alive, minimizing the effects on the environment. The design also minimizes storm damage from wind and surge effects.

ThruFlow™ panels are UV resistant and therefore keep your deck looking new for many more years than other building materials. ThruFlow™ is resistant to rot and insects, and absolutely no treating is required. ThruFlow™ panels come in a variety of colours to suit the look of your home.

ThruFlow™ panels allow debris to pass through your walking surface, keeping your walkway clean. It's non-slip strength and durability are enough to take the punishment of any high-traffic walkway.

Increase the usable space in your home with the ThruFlow™ system. Ventilated panels keep air flowing, while allowing you to walk freely throughout your attic and increase storage space.

THRUFLOW™ Interlocking Panels

1239 Dufferin Avenue, Suite B
Wallaceburg, Ontario, Canada N8A 2W3

Toll Free: 1-88-THRUFLOW (1-888-478-3569)
Facsimile: (519) 627-7428
Email: sales@thruflow.com
Website: www.thruflow.com

Installation Instructions

THRU-FLOW™
Interlocking Panels

PRODUCT DATA
INSTALLATION INSTRUCTIONS
WARRANTY INFORMATION

The complete decking system for
DOCKS, DECKS, PATIOS, WALKWAYS.
Virtually any indoor or outdoor application!

THRUFLOW™ Interlocking Panels

Easy to assemble and with no maintenance required, ThruFlow™ is designed to be the finished walkway for a dock, or any outdoor flooring structure.

ThruFlow's™ design minimizes storm damage from wind and surge effects, as well as helps to protect marine life by allowing light to penetrate waterways.

PRODUCT DATA

Material	Reinforced Polypropylene (ThruFlow™ is lightweight in comparison to other building materials)
Size	1' x 3', 1' x 4' and 1' x 5'
Load	Great Load Bearing Capability
Colours	Light Grey, Cream and Maple
Ultraviolet Protection	Full UV Protection
Light Availability	Allows Light to Penetrate
Surface	360 Degree Knurled Surface Offers Superior Grip
ThruFlow™ Warranty	Limited Warranty
(For the most up to date technical specifications including load, coefficient of friction, and coefficient of linear thermal expansion visit www.thruflow.com)	

INSTALLATION

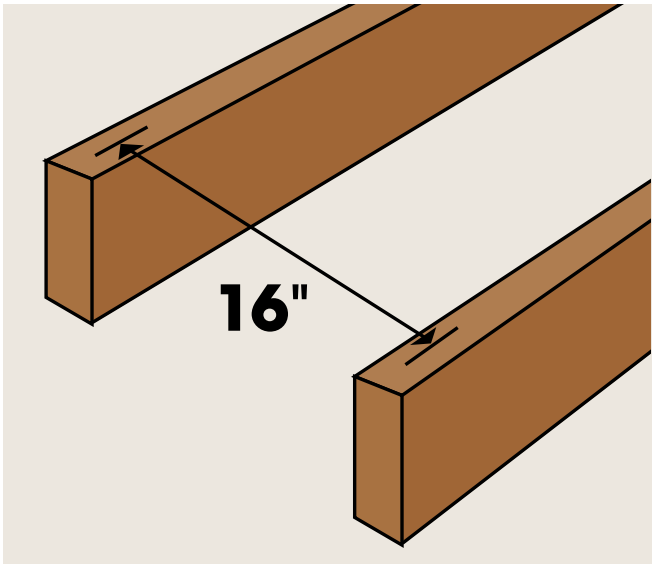
It is important that the configuration of the supporting members be designed to ensure independent structural integrity prior to installing ThruFlow™. Specifications for ThruFlow™ are available upon request.

CODES and STANDARDS: Always conform to your local building codes and the requirements of all authorities having jurisdiction.

SAFETY: Protective safety equipment is always recommended, e.g. eyewear, safety boots.

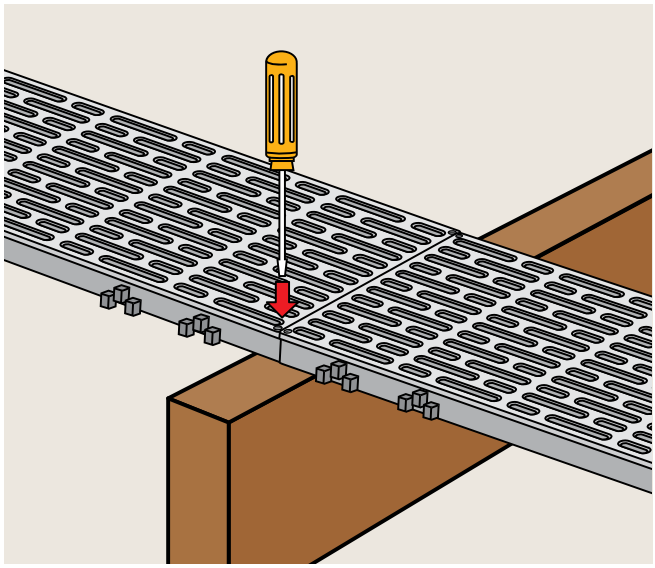
FASTENERS: We recommend high quality screws, such as #10 or #12, pan head stainless steel screws to take advantage of ThruFlow's™ longevity. Pre-drilling is not required, as the holes are molded in with a countersink for your convenience; screws should be clear through the panel and fastened into the structure of your structural frame. Remember not to tighten the screws down to allow for expansion or contraction.

GAPPING INSTRUCTIONS: While ThruFlow™ Interlocking Panels will not shrink or swell due to changes in moisture, changes in temperature will cause slight expansion/contraction. Therefore, gapping is required both side-to-side and at the panel ends to allow for thermal expansion/contraction. Rules of Thumb: ThruFlow™ Interlocking Panels should be allowed to grow a minimum of 1/16" in total length (1/32" each end) and 1/32" in total width (1/64" per side) for every 30°F of difference between installation temperature and the hottest temperature expected. In cold climate regions, gapping due to contraction of plastic will occur during colder temperatures in the exact reverse proportions of those described above. Coefficient of Linear Thermal Expansion data for the panels is available at www.thruflow.com on the specifications page.



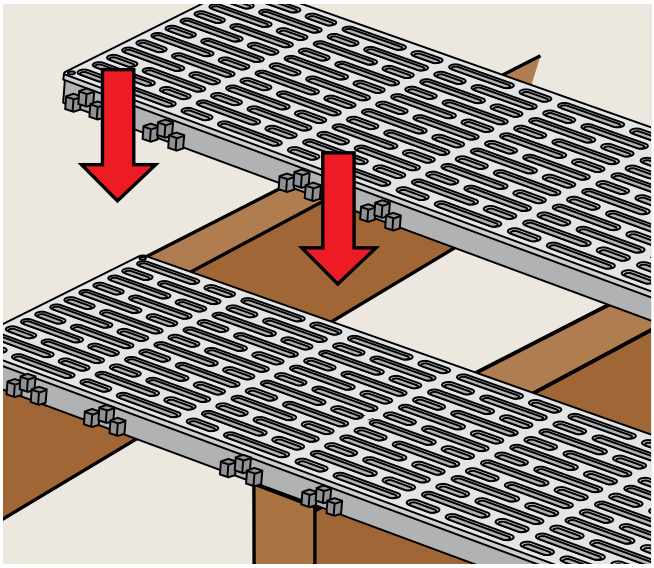
STEP 1

Substructure to be constructed with cross-members equally spaced on 18" centres (3' planks), 16" centres (4' planks) and 15" centres (5' planks).



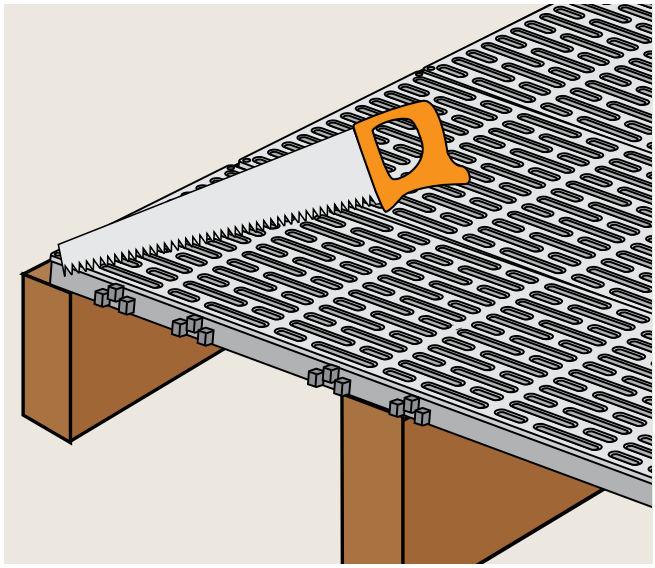
STEP 2

Lay the first ThruFlow™ on the substructure and fasten using a pan head screw. Hand tighten each screw.



STEP 3

Using the interlocking system, lay the next ThruFlow™ panel and repeat the fastening process.



STEP 4

To finish the installation, remove the last row of interlocking tabs, using any traditional hand or electric saw.

FAQ’s

Frequently Asked Questions

What are ThruFlow™ Interlocking Panels?

ThruFlow Interlocking Panels are the ideal choice for decks, docks, walkways, in the home and around pools and spas. ThruFlow is a unique polymer panel that allows water; debris and sunlight to pass through your walking surface, keeping your walking surface clean. Sunlight and water penetration in concert helps to keep vegetation alive, helping to minimize the effect of your walking surface on the environment. ThruFlow can also provide a new way to increase the usable space in your home, by decking your attic. Ventilated panels keep air flowing while allowing you to walk freely throughout your attic and increase storage space.

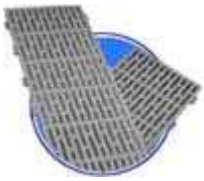
Why should I choose ThruFlow™ Interlocking Panels for my application?

ThruFlow Interlocking Panels have the perfect mix of qualities that make it a superior product to many competitors.

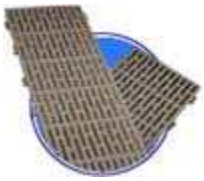
What colors does ThruFlow™ come in?

ThruFlow is currently offered in three colors; Light Grey, Sea Foam (Off-White) and Maple (Beige). Color is consistent through the entire material.

Sea Foam



Light Grey



Maple

Are ThruFlow™ Interlocking Panels made of recycled materials?

ThruFlow is made from virgin plastic reinforced with fibreglass and contains no recycled materials. The use of premium virgin plastic allows ThruFlow™ to offer increased load bearing and flexural stiffness properties. This allows ThruFlow™ to be used on 16” centers, like most existing structures, without the need for further support. ThruFlow is recyclable (subject to local regulations).

What sizes do ThruFlow™ Interlocking Panels come in?

ThruFlow is currently offered in three sizes; Three Foot Panels (12" x 36"), Four Foot Panels (12" x 48") and Five Foot Panels (12" x 60").

The **three-foot panels** are meant to cover approximately 36 inches in length and 12 inches in width with a product thickness of approximately 1.25 inches.

The **four-foot panels** are meant to cover approximately 48 inches in length and 12 inches in width with a product thickness of approximately 1.25 inches.

The **five-foot panels** are meant to cover approximately 60 inches in length and 12 inches in width with a product thickness of approximately 1.25 inches.

Will the color of ThruFlow™ change?

ThruFlow™ panels should not change color significantly (more than 15% from new) over the first 7 years of exposure.

Do ThruFlow™ Interlocking Panels come with a warranty?

Yes, ThruFlow™ has a limited warranty. The ThruFlow™ limited warranty offers coverage against

material defects in workmanship and materials, and against rot, decay and termite damage. The total life expectancy for ThruFlow™ interlocking panels is currently undetermined. Accelerated age testing is ongoing and to date we know of no environmental factors that harm or cause significant deterioration to ThruFlow™. See warranty details.

How do I dispose of ThruFlow™ panels? Can it be taken to a landfill?

ThruFlow™ contains no toxic preservatives and is recyclable. Please consult your local authorities on whether you need to recycle ThruFlow™ construction waste or dispose of with regular construction waste.

Where can you buy ThruFlow™ Interlocking Panels and how much does it cost?

ThruFlow™ is available through a network of regional distributors and local dealers. You can call 1-888-478-3569 for the dealer or distributor nearest you. You'll find that ThruFlow™ is very competitive in cost to premium grades of decking lumbers. And, since ThruFlow™ panels never require stains or sealants for protection, you will be dollars ahead in the future.

What types of fasteners are recommended for ThruFlow™ Interlocking Panels?

We recommend high quality screws such as #10 or #12 **pan head** stainless steel screw to take advantage of ThruFlow's™ longevity. Pre-drilling is not required as the holes are molded in with a countersink for your convenience, screws should be clear through the panel and fastened into the material of your structural frame. Remember not to tighten the screw down to allow for expansion or contraction.

Are ThruFlow™ Interlocking Panels structural?

No. While ThruFlow™ is tough and durable, it does not have the same stiffness as wood. Therefore, it is not intended for use as a load-bearing structural member.

What joist spans should I use for my dock, deck or walkway when using ThruFlow™?

For ThruFlow™ panels, the joist spacing should be 16" on center for all applications (18" for 3' Product, 15" for 5' Product), which is the same span generally recommended for wood. Special applications/loading conditions will require engineering analysis and/or reduced spans, please consult and adhere to your local building code.

Do ThruFlow™ Panels require gapping between panels?

Yes, in both directions. While ThruFlow™ Interlocking Panels will not shrink or swell due to changes in moisture, changes in temperature will cause slight expansion/contraction. Therefore, gapping is required both side-to-side and at the panel ends to allow for thermal expansion/contraction. Rules of Thumb: ThruFlow Interlocking Panels should be allowed to grow minimum of 1/16" in total length (1/32" each end) and 1/32" in total width (1/64" per side) for every 30℉ of difference between installation temperature and the hottest temperature expected.

Can ThruFlow™ be painted or stained?

It is not recommended to paint or stain ThruFlow™. Stain will not penetrate well and paint will not adhere well to the panel.

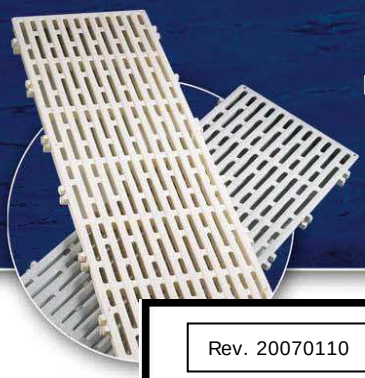
Does ThruFlow™ provide good traction?

ThruFlow's™ entire walking surface has a knurled finish for slip resistance and has been tested to provide a 0.78 static coefficient of friction.

Can ThruFlow™ be used in full ground contact? Is treating required?

ThruFlow™ is ideal for ground contact applications such as walkways and in-ground pool surrounds. ThruFlow™ is resistant to rot and insects, and absolutely no treating is required.

Technical Information



THRUFLOW™ Interlocking Panels

Rev. 20070110		NEW ThruFlow™ RPP 36	ThruFlow™ RPP 48	NEW ThruFlow™ RPP 60
Base Material		Fibre-Glass Reinforced Polypropylene	Fibre-Glass Reinforced Polypropylene	Fibre-Glass Reinforced Polypropylene
Size	(inch) (LxWxH)	12 × 36 x 1.2	12 x 48 x 1.2	12 x 60 x 1.2
	(mm) (LxWxH)	305 x 914 x 30	305 x 1219 x 30	305 x 1524 x 30
Support Span	(inch)	18	16	15
	(mm)	457	406	381
Colors Available		Cream, Light Grey, Maple		
Load Rating	(psf)	100	135	170
	(kPa)	4.8	6.5	8.1
Load at L/180	(lbf)	239	289	340
ASTM D7032	(kN)	1.06	1.29	1.51
Load at Rupture	(lbf)	1,879	2,141	2,649
ASTM D6109	(kN)	8.4	9.5	11.8
Modulus of Rupture	(psi)	7,830	7,920	9,190
ASTM D6109	(MPa)	53.99	54.61	63.36
Modulus of Elasticity	(psi)	437,000	486,000	426,000
ASTM D6109	(Mpa)	3,013	3,351	2,937
Concentrated Load	(lbf)	1,529	1,447	1,872
Support Span and Centre Applied Load	(kN)	6.80	6.44	8.33
Uniformly Distibuted Load	(psf)		157	
Australian Standard AS3962:2001	(kPa)		7.50	
Concentrated Point Load	(lbf)		473	
Australian Standard AS/NZS 1170.1: 2002	(kN)		2.10	
Creep Relaxation	(psf Load @ 24 hrs)	200	200	200
ASTM D7032	(kPa Load @ 24 hrs)	9.6	9.6	9.6
	% Recovery	92.7%	92.7%	92.7%
Notched Izod Impact	(ft-lb/in)	2.62		
ASTM D256 Ambient 23°C (73°F)	(J/m)	140		
Notched Izod Impact	(ft-lb/in)	1.23		
ASTM D256 Cold -30°C (-22°F)	(J/m)	66		
Coefficient of Friction	static	0.78		
ASTM D2394	kinetic	0.76		
Wet Pendulum Slip Resistance		46 - Classification W		
Australian Standard AS/NZS 4586:2004				
Wet Pendulum Slip Resistance		80 - Classification V		
AS/NZS 4586:2004				
Oil Ramp		18.1 degrees - Classification R10		
AS/NZS 4586:2004				
Wet Barefoot Ramp		29 degrees - Classification C		
AS/NZS 4586:2004				
Coefficient of Linear Thermal Expansion		1.40×10^{-5} 1°F		
ASTM D696		2.52×10^{-5} 1°C		
Light Penetration		Allows Light to Penetrate Walking Surface		
U/V Light Properties		U/V Stabilized by Additive		
Anti-Static Properties		Migrating Semi-Permanent Anti-Static Additive		

700 Gillard Street, Wallaceburg, Ontario, Canada N8A 4Z5
Tel: 888.478.3569 Website: www.thruflow.com

TEST REPORT

File No. 20622
PO No. D McGivern

THRUFLOW
1239 Dufferin Avenue, Suite B
Wallaceburg, ON N8A 2W3
Tel: 519 627 7428 x 112
Fax: 519 627 7428

November 5, 2006

Attention: Derek McGivern **Pages: 1**

TEST REPORT

THRUFLOW RPP DECK PANELS - DETERMINATION OF SPAN RATING

Span ratings for the 36", 48" and 60" RPP panels were determined in accordance with International Code Council practices for residential deck boards as outlined in their Acceptance Criteria AC-174 with reference to ASTM D7032-04 Section 5.3. The Unadjusted Quarter Point Load at L/180 values presented in this report were measured by Cambridge Materials Testing Limited under their laboratory no. 427785 (2006). The Quarter Point loads were converted to Unadjusted Uniform Loads using standard bending moment conversions. The Unadjusted Uniform Loads were then adjusted to account for losses in flexural properties under the most restrictive condition of high temperature exposure (ASTM D7032-04 section 5.4) The Adjusted Uniform Load measured in pounds per linear foot were directly converted to Maximum Allowable Span Rating due to the 1 ft width of the panels. The ThruFlow Load Rating was selected at a level below the Maximum Allowable Load Rating.

ThruFlow Panel	Support Span	Unadjusted Quarter Point Load at L/180 (lbf)	Unadjusted Uniform Load (plf)	Adjusted Uniform Load (plf)	Maximum Allowable Load Rating (psf / inches)	ThruFlow Load Rating (psf / inches)
3'	18"	239	159	115	115 / 18	100 / 18
4'	16"	289	217	156	156 / 16	135 / 16
5'	15"	340	272	196	196 / 15	170 / 15

AXIS Polymer Services Inc. reports are issued for the exclusive use of the clients to whom they are addressed. No quotations from the report or use of the AXIS Polymer Services Inc. name is permitted unless expressly indicated in writing. Reports apply only to the specific materials, products or processes tested, examined or surveyed and are not necessarily indicative of the qualities of apparently identical or similar materials, products or processes. Neither AXIS Polymer Services Inc. nor any of its employees shall be responsible or held liable for any claims, loss or damages arising in consequence of reliance on this report or any default, error or omission in its preparation or the tests conducted.

AXIS Polymer Services Inc.

Joe DeRose

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The information in this report may contain confidential information and therefore should be directed only to the person(s) addressed below. If you are not authorized to have this material or you have received this material in error, please either direct it to the correct individual or contact the office of the Wood Science and Technology Centre.

The test results provided in this report relate only to the specimens provided by the Client. This report should only be reproduced in its entirety and only with the authorization of the Client.

WSTC Reference #:ThruFlow0609-1

REPORT

Load Capacity Testing of ThruFlow™ Decking Panel

Submitted to:

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Prepared by:

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Andrew Sutherland, P.Tech.
Project Officer

Reviewed by:

Michael Albright
Michael Albright, P.Eng.
Manager

September 28, 2006

PREFACE

The University of New Brunswick Wood Science and Technology Centre (WSTC) has been assessed under the authority of the *Standards Council of Canada Act* and found to comply with the requirements of ISO/IEC 17025 and other conditions established by the Standards Council of Canada. WSTC is recognized as an *Accredited Testing Laboratory* for specific tests or types of tests listed in our scope of accreditation approved by the Standards Council of Canada. For the current status of our laboratory and scope of accreditation visit www.scc.ca, accredited laboratory number 108.

1.0 INTRODUCTION

AXIS Polymer Services, on behalf of ThruFlow™, has requested that the Wood Science and Technology Centre (WSTC) conduct load capacity testing on injection moulded deck perforated deck panels.

2.0 TEST MATERIALS

The test material was sent to us by Thru-Flow, login number of 6287 on 2006-09-11. Three different product sizes were tested, each product had a thickness of one and three sixteenths of an inch and a width of 11.5 inches. The lengths were five, four and three feet with each having different mounting support spans. Fasteners for mounting the planks were pan-head steel two and a half inch screws.

3.0 TESTING

3.1 Bending Test Frame

Load Capacity tests were conducted using a single span wood frame. traditional wood deck. Each deck had three panels mounted to it with the center panel the intended test piece as shown in Picture. 1. The loading head was machined from laminated veneer lumber to have a four inch diameter loading surface and length of 11.5 inches. The bending test frame had a load rate of four mm/min and recorded both cross-head movement and force.

Picture. 1

3.2 Load Capacity Results

The load-deflection curves for the samples tested are shown in Charts 1-6. The point on the curves at which the panel could no longer support the load was recorded as the Load Capacity and Deflection at Failure. These values are provided in Table 1.

Table 1.

Date Tested: September 12, 2006

ThruFlow Panel	Support Span inches (mm)	Replicate	Load Capacity		Deflection at Failure	
			lbf	kN	inches	mm
3'	**18" (457)**	1	1567	6.97	1.00	25.52
		2	1491	6.63	1.14	28.91
		Average	**1529**	**6.80**	**1.07**	**27.22**
4'	**16" (406)**	1	1457	6.48	0.81	20.68
		2	1437	6.39	0.69	17.46
		Average	**1447**	**6.44**	**0.75**	**19.07**
5'	**15" (381)**	1	1915	8.52	0.98	24.98
		2	1828	8.13	1.01	25.55
		Average	**1872**	**8.33**	**0.99**	**25.27**

Chart 1.

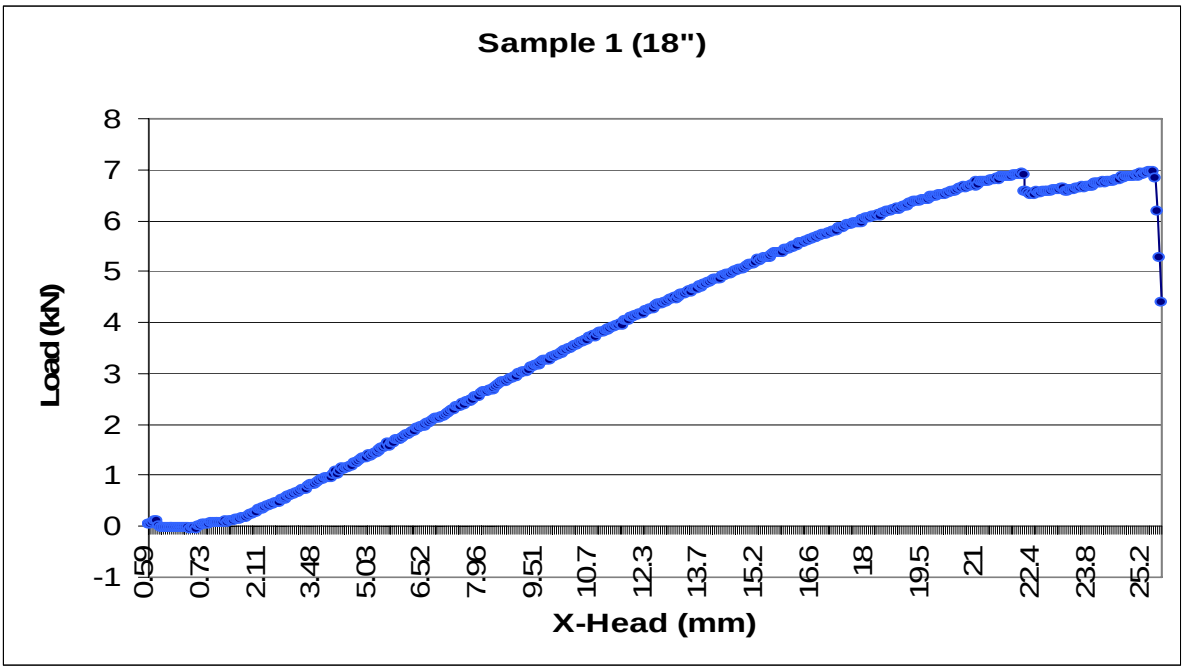

Chart 2.

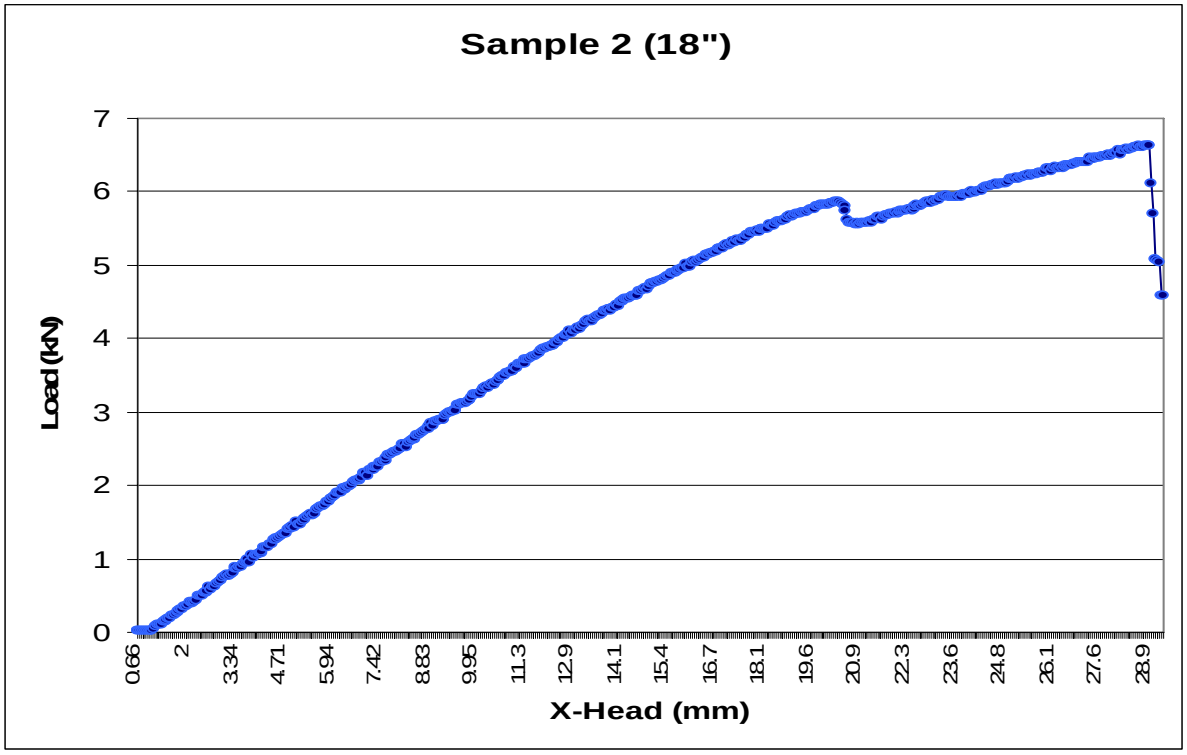

Chart 3.

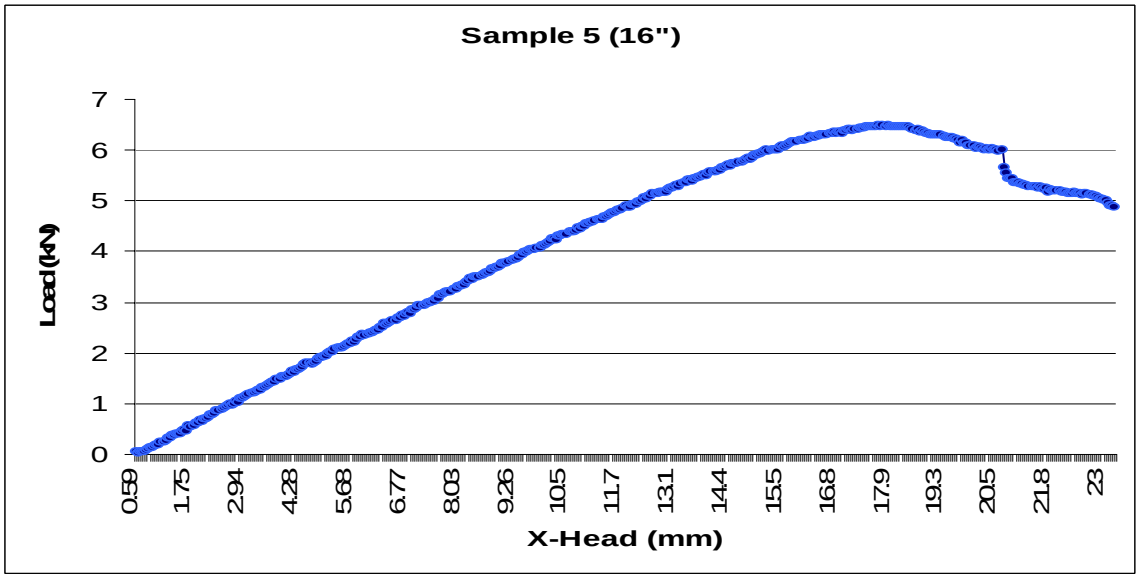

Chart 4.

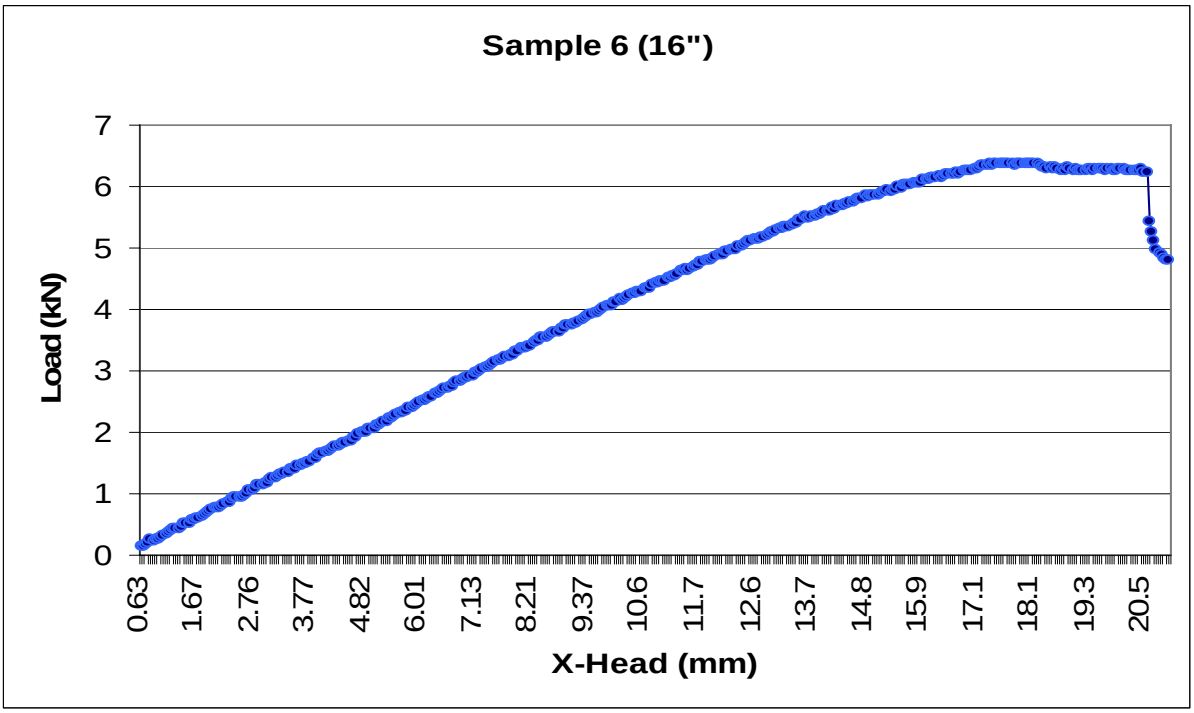

Chart 5.

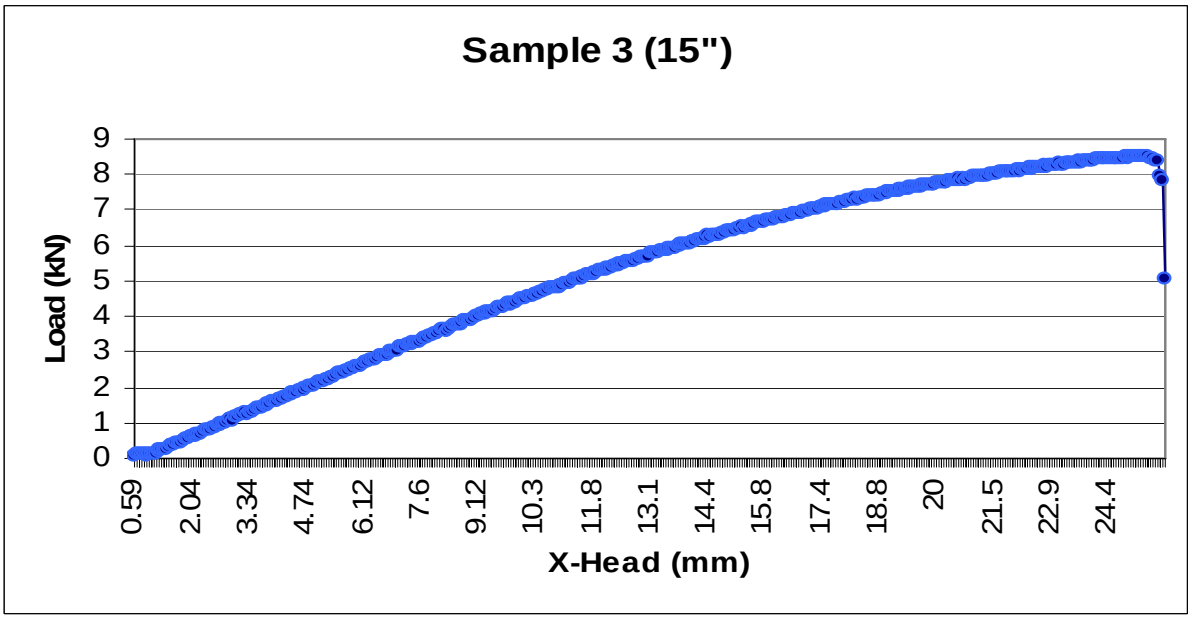

Chart 6.

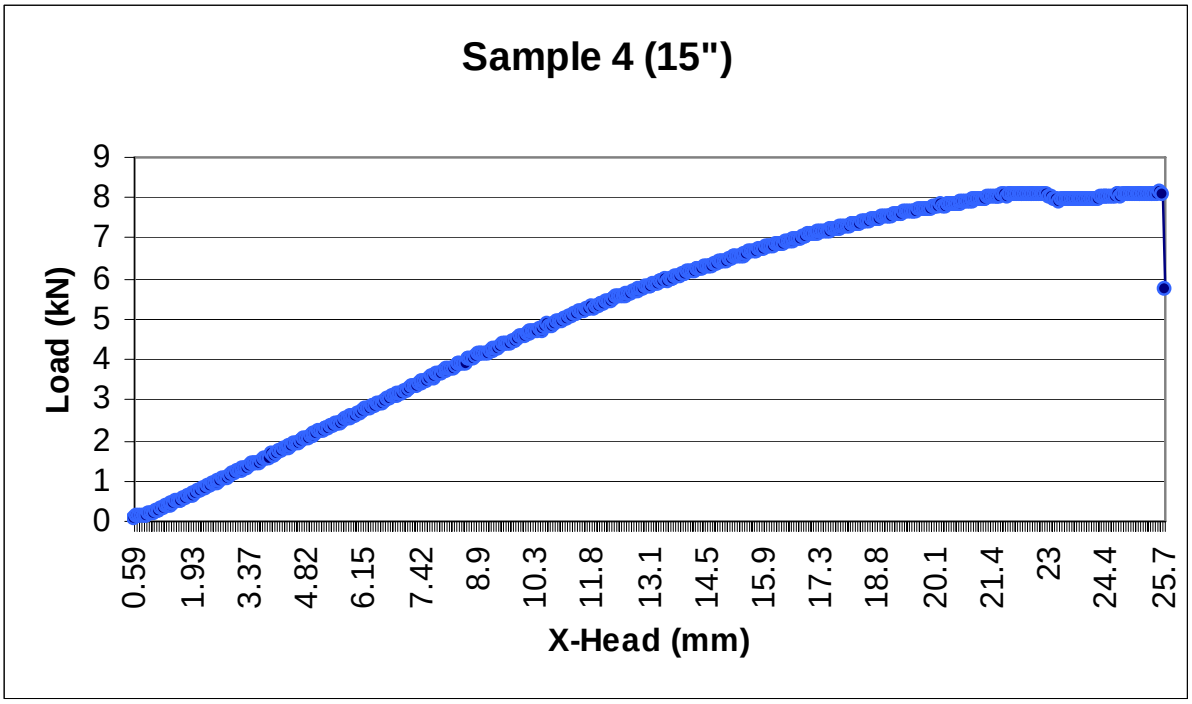

Table A1 - Test Equipment and Calibration Information

Equipment	Asset No.	Capacity	Calibrated	Accuracy
Mayes	020-1	100 kN	May. 17/06	± 1%

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Report for:	THRUFLOW P.O. Box 40, Stn. Main 1239 Dufferin Avenue, Suite B WALLACEBURG, Ontario N8A 2W3	**Laboratory #:** **Report Date:** **Received Date**:	**427785A-06** REVISION 3 October 19th, 2006 August 24th, 2006
	Phone: 519-627-7428 Ext.112 Fax: 519-627-7428 E-Mail: derekm@thruflow.com	**Customer P.O. #:**	**613**
Attention:	Derek McGivern		

TEST REPORT

PROPERTIES OF THRUFLOW DECKING PANELS

BASELINE FLEXURAL PROPERTIES

1. INTRODUCTION

On August 24th, 2006, CMTL received, a three (3) foot Thruflow Reinforced Polypropylene (RPP) dock panel to determine baseline flexural properties at 73°F as per the request of AXIS Polymer Services Inc.

2. TEST METHOD

The baseline flexural properties were determined in accordance with ASTM D6109-05, Method A procedures modified for quarter point loading and ASTM D7032-05, Section 4.4. The testing parameters used for all ASTM D6109-05 tests are outlined below.

Testing Position	Flatwise	Radius of Support Noses	2”
Nominal Sample Size	36” x 12” x 1.25”	Radius of Loading Noses	1”
Support Span	18”	Testing Machine	United SFM20
Support Span to Depth Ratio	14.4:1	Operating Software	Satec Partner
Testing Speed	0.479 “/minute	Moment of Inertia (I)	0.395 in^4
		Distance from Neutral Axis (Y)	0.731 in

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2. TEST METHOD (Cont'd)

For each flexural test conducted, the operating software recorded the deflection of the deck board at the mid-span between the supports and the corresponding load. The software calculated the slope of the load-deflection curve between the pre-selected limits corresponding to 10% and 40% of ultimate stress. A counter number was assigned to each sample tested. This counter number is identified in the results.

Five (5) boards were tested at 73+/-3°F. The key properties recorded and calculated for each board sample tested were:

Load at Rupture measured in pounds-force (lbf) – this property was extrapolated from the load-deflection curve at the point where the board samples either ruptured or reached the three percent strain limit

Load at L/180 measured in pounds-force (lbf) – this property was recorded from the load-deflection curve at the deflection corresponding to the support span (L) divided by 180.

Modulus of Rupture (MOR) measured in pounds force per square inch (psi) – this property was calculated using the following equation:

$$MOR = \frac{(\text{Peak Load} \times \text{Support Span} \times \text{Distance from Neutral Axis})}{(8 \times \text{Moment of Inertia})}$$

Slope of Tangent measured in lbf/in – this property was recorded from the load-deflection curve between 10% and 40% of the ultimate stress.

Modulus of Elasticity (MOE) measured in pounds force per square inch (psi) – this property was calculated using the following equation:

$$MOE = \frac{(\text{Support Span}^3 \times \text{Slope of Tangent to Load-Deflection Curve} \times \text{Distance from Neutral Axis})}{(34.9 \times \text{Depth} \times \text{Moment of Inertia})}$$

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Laboratory #427785A-06
REVISION 3
AXIS Polymer Services Inc.

3. RESULTS

18" Support Span

Sample I.D.*	Counter Number	Load at Rupture (lbf)	Load at L/180 (lbf)	MOR (psi)	Slope of Tangent (lbf/in)	MOE (psi)
1	19105	1,846	239	7,680	1,825	452,000
2	19107	1,847	234	7,690	1,689	418,000
3	19109	1,856	235	7,730	1,688	418,000
4	19111	1,965	241	7,180	1,805	447,000
5	19113	1,884	246	7,850	1,813	449,000
Mean		**1,879**	**239**	**7,830**	**1,764**	**437,000**
Standard Deviation +/-		**50**	**5**	**209**	**69**	**17,300**

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	Phone: 519-627-7428 Ext.112 Fax: 519-627-7428 E-Mail: derekm@thruflow.com	**Customer P.O. #:**	**613**
Attention:	Derek McGivern		

TEST REPORT

PROPERTIES OF THRUFLOW DECKING PANELS

BASELINE FLEXURAL PROPERTIES

1. INTRODUCTION

On August 24th, 2006, CMTL received, a four (4) foot Thruflow Reinforced Polypropylene (RPP) dock panel to determine baseline flexural properties at 73°F as per the request of AXIS Polymer Services Inc.

2. TEST METHOD

The baseline flexural properties were determined in accordance with ASTM D6109-05, Method A procedures modified for quarter point loading and ASTM D7032-05, Section 4.4. The testing parameters used for all ASTM D6109-05 tests are outlined below.

Testing Position	Flatwise	Radius of Support Noses	2”
Nominal Sample Size	48” x 12” x 1.25”	Radius of Loading Noses	1”
Support Span	16”	Testing Machine	United SFM20
Support Span to Depth Ratio	12.8:1	Operating Software	Satec Partner
Testing Speed	0.378 “/minute	Moment of Inertia (I)	0.395 in^4
		Distance from Neutral Axis (Y)	0.731 in

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2. TEST METHOD (Cont'd)

For each flexural test conducted, the operating software recorded the deflection of the deck board at the mid-span between the supports and the corresponding load. The software calculated the slope of the load-deflection curve between the pre-selected limits corresponding to 10% and 40% of ultimate stress. A counter number was assigned to each sample tested. This counter number is identified in the results.

Five (5) boards were tested at 73+/-3°F. The key properties recorded and calculated for each board sample tested were:

Load at Rupture measured in pounds-force (lbf) – this property was extrapolated from the load-deflection curve at the point where the board samples either ruptured or reached the three percent strain limit

Load at L/180 measured in pounds-force (lbf) – this property was recorded from the load-deflection curve at the deflection corresponding to the support span (L) divided by 180.

Modulus of Rupture (MOR) measured in pounds force per square inch (psi) – this property was calculated using the following equation:

$$MOR = \frac{(\text{Peak Load} \times \text{Support Span} \times \text{Distance from Neutral Axis})}{(8 \times \text{Moment of Inertia})}$$

Slope of Tangent measured in lbf/in – this property was recorded from the load-deflection curve between 10% and 40% of the ultimate stress.

Modulus of Elasticity (MOE) measured in pounds force per square inch (psi) – this property was calculated using the following equation:

$$MOE = \frac{(\text{Support Span}^3 \times \text{Slope of Tangent to Load-Deflection Curve} \times \text{Distance from Neutral Axis})}{(34.9 \times \text{Depth} \times \text{Moment of Inertia})}$$

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3. RESULTS

16" Support Span

Sample I.D.*	Counter Number	Load at Rupture (lbf)	Load at L/180 (lbf)	MOR (psi)	Slope of Tangent (lbf/in)	MOE (psi)
1	19083	2,046	289	7,570	2,792	485,000
2	19085	2,340	280	8,660	2,873	499,000
3	19087	2,312	325	8,560	2,851	495,000
4	19089	1,913	287	7,080	2,695	468,000
5	19091	2,091	267	7,740	2,770	481,000
Mean		**2,141**	**289**	**7,920**	**2,796**	**486,000**
Standard Deviation +/-		**182**	**22**	**674**	**70**	**12,200**

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Report for:	THRUFLOW P.O. Box 40, Stn. Main 1239 Dufferin Avenue, Suite B WALLACEBURG, Ontario N8A 2W3	**Laboratory #:** **Report Date:** **Received Date**:	**427785C-06** REVISION 3 October 19th, 2006 August 24th, 2006
	Phone: 519-627-7428 Ext.112 Fax: 519-627-7428 E-Mail: derekm@thruflow.com	**Customer P.O. #:**	**613**
Attention:	Derek McGivern		

TEST REPORT

PROPERTIES OF THRUFLOW DECKING PANELS

BASELINE FLEXURAL PROPERTIES

1. INTRODUCTION

On August 24th, 2006, CMTL received, a five (5) foot Thruflow Reinforced Polypropylene (RPP) dock panel to determine baseline flexural properties at 73°F as per the request of AXIS Polymer Services Inc.

2. TEST METHOD

The baseline flexural properties were determined in accordance with ASTM D6109-05, Method A procedures modified for quarter point loading and ASTM D7032-05, Section 4.4. The testing parameters used for all ASTM D6109-05 tests are outlined below.

Testing Position	Flatwise	Radius of Support Noses	2”
Nominal Sample Size	60” x 12” x 1.25”	Radius of Loading Noses	1”
Support Span	15”	Testing Machine	United SFM20
Support Span to Depth Ratio	12:1	Operating Software	Satec Partner
Testing Speed	0.333 “/minute	Moment of Inertia (I)	0.395 in^4
		Distance from Neutral Axis (Y)	0.731 in

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2. TEST METHOD (Cont'd)

For each flexural test conducted, the operating software recorded the deflection of the deck board at the mid-span between the supports and the corresponding load. The software calculated the slope of the load-deflection curve between the pre-selected limits corresponding to 10% and 40% of ultimate stress. A counter number was assigned to each sample tested. This counter number is identified in the results.

Five (5) boards were tested at 73+/-3°F. The key properties recorded and calculated for each board sample tested were:

Load at Rupture measured in pounds-force (lbf) – this property was extrapolated from the load-deflection curve at the point where the board samples either ruptured or reached the three percent strain limit

Load at L/180 measured in pounds-force (lbf) – this property was recorded from the load-deflection curve at the deflection corresponding to the support span (L) divided by 180.

Modulus of Rupture (MOR) measured in pounds force per square inch (psi) – this property was calculated using the following equation:

$$MOR = \frac{(\text{Peak Load} \times \text{Support Span} \times \text{Distance from Neutral Axis})}{(8 \times \text{Moment of Inertia})}$$

Slope of Tangent measured in lbf/in – this property was recorded from the load-deflection curve between 10% and 40% of the ultimate stress.

Modulus of Elasticity (MOE) measured in pounds force per square inch (psi) – this property was calculated using the following equation:

$$MOE = \frac{(\text{Support Span}^3 \times \text{Slope of Tangent to Load-Deflection Curve} \times \text{Distance from Neutral Axis})}{(34.9 \times \text{Depth} \times \text{Moment of Inertia})}$$

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3. RESULTS

15" Support Span

Sample I.D.*	Counter Number	Load at Rupture (lbf)	Load at L/180 (lbf)	MOR (psi)	Slope of Tangent (lbf/in)	MOE (psi)
1	19093	2,774	334	9,620	3,113	446,000
2	19095	2,321	329	8,050	2,926	419,000
3	19097	2,714	354	9,420	2,953	423,000
4	19099	2,734	348	9,490	2,980	427,000
5	19101	2,703	337	9,380	2,910	417,000
Mean		**2,649**	**340**	**9,190**	**2,976**	**426,000**
Standard Deviation +/-		**185**	**11**	**645**	**81**	**11,600**

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Report for:	THRUFLOW P.O. Box 40, Stn. Main 1239 Dufferin Avenue, Suite B WALLACEBURG, Ontario N8A 2W3	**Laboratory #:** **Report Date:** **Received Date**:	**427785G-06** REVISION 3 October 19th, 2006 August 24th, 2006
	Phone: 519-627-7428 Ext.112 Fax: 519-627-7428 E-Mail: derekm@thruflow.com	**Customer P.O. #:**	**613**
Attention:	Derek McGivern		

TEST REPORT

PROPERTIES OF THRUFLOW DECKING PANELS

FLEXURAL PROPERTIES AT ELEVATED TEMPERATURES

1. INTRODUCTION

On August 24th, 2006, CMTL received, a four (4) foot Thruflow Reinforced Polypropylene (RPP) dock panel to determine flexural properties at 126°F as per the request of AXIS Polymer Services Inc.

2. TEST METHOD

The flexural properties were determined in accordance with ASTM D6109-05, Method A procedures modified for quarter point loading and ASTM D7032-05, Section 4.4. The testing parameters used for all ASTM D6109-05 tests are outlined below.

Testing Position	Flatwise	Radius of Support Noses	2”
Nominal Sample Size	48” x 12” x 1.25”	Radius of Loading Noses	1”
Support Span	16”	Testing Machine	United SFM20
Support Span to Depth Ratio	12.8:1	Operating Software	Satec Partner
Testing Speed	0.378 “/minute	Moment of Inertia (I)	0.395 in^4
		Distance from Neutral Axis (Y)	0.731 in

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2. TEST METHOD (Cont'd)

For each flexural test conducted, the operating software recorded the deflection of the deck board at the mid-span between the supports and the corresponding load. The software calculated the slope of the load-deflection curve between the pre-selected limits corresponding to 10% and 40% of ultimate stress. A counter number was assigned to each sample tested. This counter number is identified in the results.

Five (5) boards were tested at 126+/-3°F. The key properties recorded and calculated for each board sample tested were:

Load at Rupture measured in pounds-force (lbf) – this property was extrapolated from the load-deflection curve at the point where the board samples either ruptured or reached the three percent strain limit

Load at L/180 measured in pounds-force (lbf) – this property was recorded from the load-deflection curve at the deflection corresponding to the support span (L) divided by 180.

Modulus of Rupture (MOR) measured in pounds force per square inch (psi) – this property was calculated using the following equation:

$$MOR = \frac{(\text{Peak Load} \times \text{Support Span} \times \text{Distance from Neutral Axis})}{(8 \times \text{Moment of Inertia})}$$

Slope of Tangent measured in lbf/in – this property was recorded from the load-deflection curve between 10% and 40% of the ultimate stress.

Modulus of Elasticity (MOE) measured in pounds force per square inch (psi) – this property was calculated using the following equation:

$$MOE = \frac{(\text{Support Span}^3 \times \text{Slope of Tangent to Load-Deflection Curve} \times \text{Distance from Neutral Axis})}{(34.9 \times \text{Depth} \times \text{Moment of Inertia})}$$

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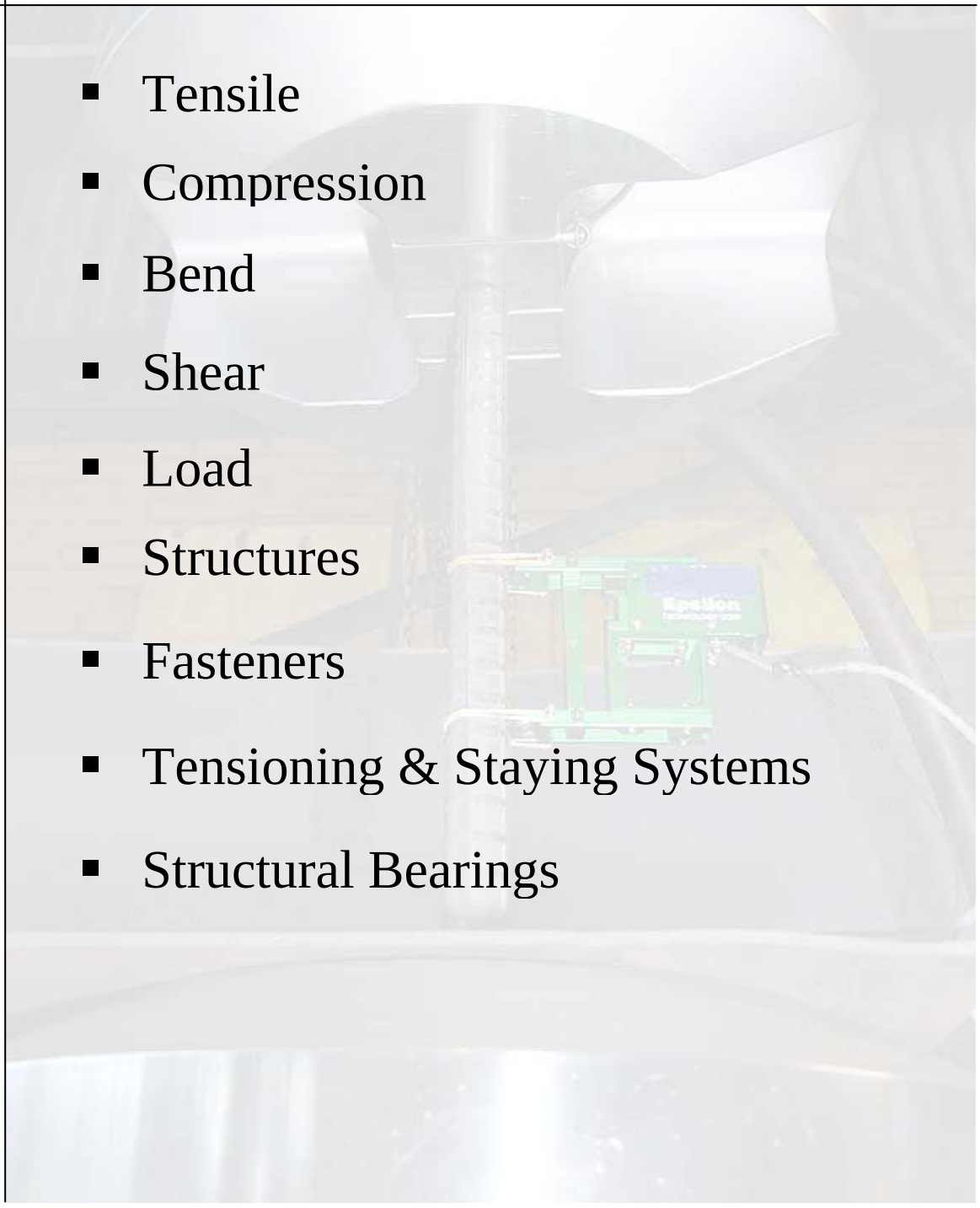
3. RESULTS

16" Support Span

Sample I.D.	Counter Number	Load at Rupture (lbf)	Load at L/180 (lbf)	MOR (psi)	Slope of Tangent (lbf/in)	MOE (psi)
1	19115	1,883	226	6,970	2,222	386,000
2	19117	1,334	251	4,940	1,978	344,000
3	19119	1,736	239	6,430	1,973	343,000
4	19123	1,720	244	6,370	1,920	334,000
5	19125	1,355	237	5,020	2,009	349,000
Mean		**1,606**	**239**	**5,950**	**2,020**	**351,000**
Standard Deviation +/-		**247**	**9**	**913**	**117**	**20,200**

Melbourne Testing Services

Mechanical Testing



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Telephone: 03 9560 2759, Facsimile: 03 9560 2769, Mobile: 0419 116 733
E-mail: rodwilkie@melbtest.com.au Web Site: www.melbtest.com.au

Melbourne Testing Services

Unit 1/15 Pickering Road
Mulgrave Victoria 3170
Telephone 03 9560 2759
Mobile 0419 116 733

IN CONFIDENCE TO THE CLIENT

REPORT NO: MT-06/169

TESTING OF THRUFLOW WALKWAY PANELS

CLIENT: **DAVID PADFIELD**
ATTAR
PO BOX 286
SPRINGVALE VIC 3171

DATE OF TESTING: MAY 25TH 2006

DATE OF REPORT: MAY 25TH 2006

TEST SYNOPSIS:

Two ThruFlow walkway panels were delivered to the Melbourne Testing Services laboratory for load testing (See Fig.1). Upon arrival at the laboratory the test items were measured and the following dimensions were recorded:

Length: 1220mm

Width: 300mm

Depth: 30mm

At the request of the client load testing was to be conducted on the ThruFlow panels to determine if the panels could support test loads commensurate with the requirements of:

- AS/NZS 1170.1 STRUCTURAL DESIGN ACTIONS. PART 1: PERMANENT, IMPOSED AND OTHER ACTIONS.
- AS 3962-2001 GUIDELINES FOR MARINAS.

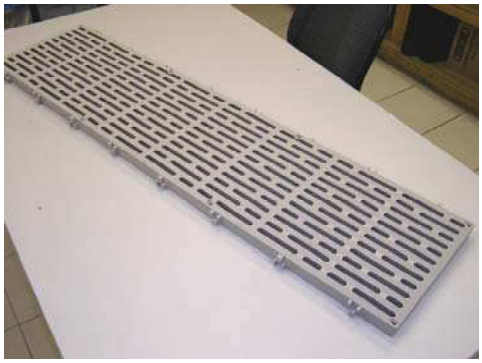

FIG.1.
TEST ITEM

TEST PROCEDURES:

Two tests were conducted in accordance with the following procedures:

1. A Simulated Uniformly Distributed Load (UDL) commensurate with a factored uniform pressure of 7.5kPa.
2. Concentrated load test of 2.1kN over an area of 350mm^2 (See Fig.2). *(Note that this test was conducted strictly in accordance with the clients, own clients instructions, using a linear load applicator measuring 58.3mm long x 6.0mm wide (350mm^2). Load was applied in the mid-span region of the panel and bearing over three of the panels longitudinal ribs).*

Both tests were conducted for 15 minutes during which time the applied load and panel deflection was recorded. At the completion of testing the test panels were visibly inspected for signs of failure and the residual deflection was calculated.

The tests reported herein have been performed in accordance with approved Melbourne Testing Services procedures. This document shall not be reproduced except in full.

TEST OBSERVATIONS:

UDL Test

The test panel supported the test load 2.75kN (7.5kPa) without visible sign of failure or excessive permanent deflection. The residual deflection recorded at completion of testing was calculated to be 2.8%. This is less than the maximum allowable value of 5.0% as specified in AS 3962:2001 Appendix B.

Concentrated Load Test

The test panel supported the factored test load of 2.1kN as required by AS/NZS 1170.1:2002 Table B1, without visible sign of failure. The residual deflection recorded at completion of testing was calculated to be 4.5%. This is less than the maximum allowable value of 5.0% as specified in AS 3962:2001 Appendix B.

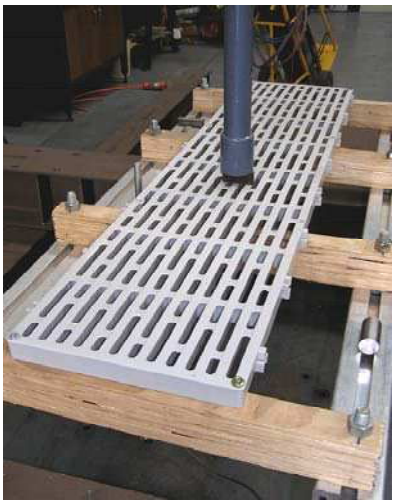

FIG.2.
CONCENTRATED LOAD TEST

Notes:

1) This report only indicates compliance of the ThruFlow walkway panel for uniform loading in its state at the time of testing. It should not be taken as a statement that all similar walkway panels or components of walkway panels in all states of repair, would also be found to comply.
2) It remains the responsibility of the client to ensure that the samples tested are representative of the entire product batch.
3) This report only covers the structural integrity of the ThruFlow walkway panel as tested and as described herein.
4) This report does not cover the actual walkway support structure or fixing of ThruFlow walkway panels.
5) Melbourne Testing Services shall take no responsibility for the results of testing or conformance of the ThruFlow walkway panel where the panel was tested for concentrated loading.

RODNEY WILKIE
AUTHORISED SIGNATORY

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Report for:	THRUFLOW P.O. Box 40, Stn. Main 1239 Dufferin Avenue, Suite B WALLACEBURG, Ontario N8A 2W3	**Laboratory #:** **Report Date:** **Received Date**:	**427785D-06** REVISED October 19th, 2006 August 24th, 2006
	Phone: 519-627-7428 Ext.112 Fax: 519-627-7428 E-Mail: derekm@thruflow.com	**Customer P.O. #:**	**613**
Attention:	Derek McGivern		

TEST REPORT

PROPERTIES OF THRUFLOW DECKING PANELS

CREEP RELAXATION

1. INTRODUCTION

On August 24th, 2006, CMTL received, a three (3) foot Thruflow Reinforced Polypropylene (RPP) dock panel to determine the creep relaxation properties at 73°F as per the request of AXIS Polymer Services Inc.

2. TEST METHOD

The Thruflow dock panel was tested according to the creep relaxation requirements outlined in ICC AC174 (Approved Feb. 2005) and ASTM D7032-05, Section 5.4. The testing was conducted using a support span of 18 inches on center for three (3) foot panels.

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2. TEST METHOD (Cont'd)

Three (3) boards were tested as per ASTM D6109-05 modified for quarter point loading. The boards were placed across the support noses. A calibrated dial gauge was secured under the deck boards and the initial deflection at the mid-span was recorded. A pre-weighed loading nose assembly was placed on the boards. Weights were added to the assembly until a load corresponding to 100 psf, 120 psf, 140 psf, 160 psf and 200 psf (2x design load) were applied. The 200 psf load was left in place for 24 hours and the total deflection was recorded. The load was removed and deflection was recorded immediately. The boards were allowed to recover for 24 hours at which time the deflection was measured. The percent recovered deflection was calculated as follows:

Percent recovered deflection =

$$\frac{\text{(total deflection after 24hr loading period – residual deflection after 24hr recovery period)}}{\text{total deflection after 24hr loading period}} \times 100$$

3. RESULTS

18" Support Span

	Deflection (inches)			
	Board 1	**Board 2**	**Board 3**	**Mean**
100 psf	0.0893	0.0872	0.0807	0.0857
120 psf	0.1087	0.1058	0.0987	0.1044
140 psf	0.1253	0.1227	0.1163	0.1214
160 psf	0.1440	0.1428	0.1365	0.1411
– total deflection after 24hr loading period	0.2377	0.2304	0.2205	0.2295
– residual deflection after 24hr recovery period	0.0168	0.0144	0.0127	0.0146
– percent recovered deflection	+93%	+94%	+94%	+94%

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Report for:	THRUFLOW P.O. Box 40, Stn. Main 1239 Dufferin Avenue, Suite B WALLACEBURG, Ontario N8A 2W3	**Laboratory #:** **Report Date:** **Received Date**:	**427785E-06** REVISED October 19th, 2006 August 24th, 2006
	Phone: 519-627-7428 Ext.112 Fax: 519-627-7428 E-Mail: derekm@thruflow.com	**Customer P.O. #:**	**613**
Attention:	Derek McGivern		

TEST REPORT

PROPERTIES OF THRUFLOW DECKING PANELS

CREEP RELAXATION

1. INTRODUCTION

On August 24th, 2006, CMTL received, a four (4) foot Thruflow Reinforced Polypropylene (RPP) dock panel to determine the creep relaxation properties at 73°F as per the request of AXIS Polymer Services Inc.

2. TEST METHOD

The Thruflow dock panel was tested according to the creep relaxation requirements outlined in ICC AC174 (Approved Feb. 2005) and ASTM D7032-05, Section 5.4. The testing was conducted using a support span of 16 inches on center for four (4) foot panels.

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2. TEST METHOD (Cont'd)

Three (3) boards were tested as per ASTM D6109-05 modified for quarter point loading. The boards were placed across the support noses. A calibrated dial gauge was secured under the deck boards and the initial deflection at the mid-span was recorded. A pre-weighed loading nose assembly was placed on the boards. Weights were added to the assembly until a load corresponding to 100 psf, 120 psf, 140 psf, 160 psf and 200 psf (2x design load) were applied. The 200 psf load was left in place for 24 hours and the total deflection was recorded. The load was removed and deflection was recorded immediately. The boards were allowed to recover for 24 hours at which time the deflection was measured. The percent recovered deflection was calculated as follows:

Percent recovered deflection =

$$\frac{\text{(total deflection after 24hr loading period – residual deflection after 24hr recovery period)}}{\text{total deflection after 24hr loading period}} \times 100$$

3. RESULTS

16" Support Span

	Deflection (inches)			
	Board 1	**Board 2**	**Board 3**	**Mean**
100 psf	0.0516	0.0539	0.0467	0.0507
120 psf	0.0653	0.0682	0.0605	0.0647
140 psf	0.0745	0.0783	0.0701	0.0743
160 psf	0.0857	0.0906	0.0812	0.0858
– total deflection after 24hr loading period	0.1244	0.1300	0.1212	0.1252
– residual deflection after 24hr recovery period	0.0010	0.0154	0.0063	0.0076
– percent recovered deflection	+99%	+88%	+95%	+94%

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Attention:	Derek McGivern		

TEST REPORT

PROPERTIES OF THRUFLOW DECKING PANELS

CREEP RELAXATION

1. INTRODUCTION

On August 24th, 2006, CMTL received, a five (5) foot Thruflow Reinforced Polypropylene (RPP) dock panel to determine the creep relaxation properties at 73°F as per the request of AXIS Polymer Services Inc.

2. TEST METHOD

The Thruflow dock panel was tested according to the creep relaxation requirements outlined in ICC AC174 (Approved Feb. 2005) and ASTM D7032-05, Section 5.4. The testing was conducted using a support span of 15 inches on center for five (5) foot panels.

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2. TEST METHOD (Cont'd)

Three (3) boards were tested as per ASTM D6109-05 modified for quarter point loading. The boards were placed across the support noses. A calibrated dial gauge was secured under the deck boards and the initial deflection at the mid-span was recorded. A pre-weighed loading nose assembly was placed on the boards. Weights were added to the assembly until a load corresponding to 100 psf, 120 psf, 140 psf, 160 psf and 200 psf (2x design load) were applied. The 200 psf load was left in place for 24 hours and the total deflection was recorded. The load was removed and deflection was recorded immediately. The boards were allowed to recover for 24 hours at which time the deflection was measured. The percent recovered deflection was calculated as follows:

Percent recovered deflection =

$$\frac{\text{(total deflection after 24hr loading period – residual deflection after 24hr recovery period)}}{\text{total deflection after 24hr loading period}} \times 100$$

3. RESULTS

15" Support Span

	Deflection (inches)			
	Board 1	**Board 2**	**Board 3**	**Mean**
100 psf	0.0397	0.0355	0.0313	0.0355
120 psf	0.0469	0.0438	0.0397	0.0434
140 psf	0.0546	0.0516	0.0481	0.0514
160 psf	0.0632	0.0590	0.0553	0.0591
– total deflection after 24hr loading period	0.0970	0.0938	0.0901	0.0936
– residual deflection after 24hr recovery period	0.0094	0.0074	0.0076	0.0081
– percent recovered deflection	+90%	+92%	+92%	+91%

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Report For:	**Thruflow Inc.** P.O. Box 40 760 Lowe Avenue Wallaceburg, ON Canada N8A 4Z9 Phone: 519 627 7960 Fax: 519 627 7969	**Laboratory #:**	356155E-04
		Report Date:	April 20, 2004
		Received Date:	March 29, 2004
		Customer P.O.#:	4
Attention:	Derek McGivern		

TEST REPORT

IZOD IMPACT

THRUFLOW 4' GFPP DOCK PANEL

1. INTRODUCTION

Six specimens from the 4' GFPP dock panel identified as "new 4' panel, beige, 356155-3" were machined, notched and tested for Izod Impact testing in accordance with ASTM D256-03, Method A using a 2 lb pendulum. The Izod specimens were taken from the rib of the panel. The width of the specimens had a taper of 0.018 – 0.031 in. and as such are considered non-conforming as per ASTM D256-03 Sec 7.2. Results were calculated using the average width of each Izod specimen. The specimens were conditioned a minimum of 16 hours at –34.4 ± 2℃ or 40 hours at 23 ± 2℃ and 50 ± 5% R.H. as appropriate, prior to testing. At the cold temperature specimens were impacted within 5 seconds of removal from the cold chamber. The average width of the specimens was 0.116 to 0.120 inches.

2. RESULTS

16 Hours @ -34.4 ± 2℃

Impact Strength (ft·lb/in)	Type of Failure
1.16	Complete Break
1.40	Complete Break
1.12	Complete Break
Avg. = 1.23 ft·lb/in	

Ambient

Impact Strength (ft·lb/in)	Type of Failure
2.48	Partial Break
2.51	Partial Break
2.68	Partial Break
Avg. = 2.62 ft·lb/in	

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Report For:	**Thruflow Inc.** P.O. Box 40 760 Lowe Avenue Wallaceburg, ON Canada N8A 4Z9 Phone: 519 627 7960 Fax: 519 627 7969	**Laboratory #:** **Report Date:** **Received Date:** **Customer P.O.#:**	356155J-04 April 30, 2004 March 29, 2004 4
Attention:	Derek McGivern		

TEST REPORT

COEFFICIENT OF FRICTION

4' GFPP THRUFLOW DOCK PANEL

One panel section was subjected to friction testing to determine the static and kinetic coefficients of friction. Three replicates per condition were tested. A sled with Topy brand shoe sole rubber sample was used. Testing was performed in accordance with ASTM D2394-83(1999) with a test speed of 0.05"/minute for the static coefficient of friction and 2"/minute for the kinetic coefficient of friction. The sled weight was 24 lbs.

RESULTS

Sample ID	Replicate	Static Coefficient of Friction	Kinetic Coefficient of Friction
4' GFPP	1-A	0.772	0.758
	1-B	0.826	0.751
	1-C	0.739	0.767
	Average	**0.779**	**0.759**

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*Materials Failure Analysis *Corrosion Monitoring
*Non-Destructive Testing Training

A Division of Engineering Materials Evaluation Pty. Ltd.
A.B.N. 14 006 554 785

ATTAR TEST REPORT NUMBER: 06/0826.2

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June 7, 2006

Total Pages: 1

WET SLIP RESISTANCE

Job No: M06/0826

Prepared for:	Arrk Australia & New Zealand Pty Ltd. 5 Lynch Street HAWTHORN VIC 3122
Attention:	Tim Lawson
Test Site:	ATTAR, Unit 27, 134 Springvale Road, Springvale.
Test Date:	May 30, 2006
Test Specimens, Size & Quantity:	Thruflow walkway panels, 122cm x 29.5cm, 2 off.
Sampling & Direction of Testing:	Sampling conducted by client. Tested in the longitudinal direction.
Test Personnel:	John Dimopoulos
Preparation:	As received, washed in tap water and methylated spirits and dried.
Fixed/Unfixed:	Unfixed.
Air Temperature:	21ºC
Test Equipment:	Stanley Skid Resistance Tester (Pendulum) Serial Number 8117, Calibrated 11/04/2006.
Test Standard:	AS/NZS 4586 - 2004 Slip resistance classification of new pedestrian surface materials – Appendix A.
Slider Rubber:	Slider 55 (TRL) Batch No. 14
Classification Criteria:	Refer Appendix 3 – Classification Criteria, attached.

British Pendulum Number	**Specimen Number**					**Mean**
	1	2	3	4	5	
	80	80	79	79	81	80
Classification:	**V**					

These results apply only to the specimens tested and it is recommended that before selection of flooring or paving materials the effect of service conditions, including maintenance procedures and wear on their slip-resistance be checked.

NOTE: Any specimens supplied will be disposed of in two (2) months time, unless otherwise instructed.

ATTAR

D. Padfield

David Padfield
Materials Engineer

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*Materials Failure Analysis *Corrosion Monitoring
*Non-Destructive Testing Training

A Division of Engineering Materials Evaluation Pty. Ltd.
A.B.N. 14 006 554 785

ATTAR TEST REPORT NUMBER: 06/0826.1

This document is issued in accordance with NATA's accreditation requirements. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025.

June 7, 2006

Total Pages: 1

WET SLIP RESISTANCE

Job No: M06/0826

Prepared for:	Arrk Australia & New Zealand Pty Ltd. 5 Lynch Street HAWTHORN VIC 3122
Attention:	Tim Lawson
Test Site:	ATTAR, Unit 27, 134 Springvale Road, Springvale.
Test Date:	May 30, 2006
Test Specimens, Size & Quantity:	Thruflow walkway panels, 122cm x 29.5cm, 2 off.
Sampling & Direction of Testing:	Sampling conducted by client. Tested in the longitudinal direction.
Test Personnel:	John Dimopoulos
Preparation:	As received, washed in tap water and methylated spirits and dried.
Fixed/Unfixed:	Unfixed.
Air Temperature:	21ºC
Test Equipment:	Stanley Skid Resistance Tester (Pendulum) Serial Number 8117, Calibrated 11/04/2006.
Test Standard:	AS/NZS 4586 - 2004 Slip resistance classification of new pedestrian surface materials – Appendix A.
Slider Rubber:	Slider 96 (Four S) Batch No. 14
Classification Criteria:	Refer Appendix 3 – Classification Criteria, attached.

British Pendulum Number	**Specimen Number**					**Mean**
	1	2	3	4	5	
	44	45	45	46	49	46
Classification:	**W**					

These results apply only to the specimens tested and it is recommended that before selection of flooring or paving materials the effect of service conditions, including maintenance procedures and wear on their slip-resistance be checked.

NOTE: Any specimens supplied will be disposed of in two (2) months time, unless otherwise instructed.

ATTAR

D. Padfield

David Padfield
Materials Engineer

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ATTAR
Advanced Technology Testing and Research

*Acoustic Emission * Slip Resistance Testing
*Materials Failure Analysis *Corrosion Monitoring
*Non-Destructive Testing Training

A Division of Engineering Materials Evaluation Pty. Ltd.
A.B.N. 14 006 554 785

ATTAR TEST REPORT NUMBER: 06/0826.3

June 7, 2006 **Total Pages: 1**

OIL-WET RAMP SLIP RESISTANCE Job No: M06/0826

Prepared for:	Arrk Australia & New Zealand Pty Ltd. 5 Lynch Street HAWTHORN VIC 3122	
Attention:	Mr Tim Lawson	
Test Site:	ATTAR, Unit 27, 134 Springvale Road, Springvale.	
Test Date:	May 31, 2006	
Manufacturer:	Thruflow	
Test Specimen, Size & Quantity Received:	Thruflow walkway panel, 122cm x 29.5cm, 2 off.	
Sampling & Direction of Testing:	Sampling conducted by client. Tested in the longitudinal direction.	
Test Personnel:	Marcus Braché & David Padfield	
Preparation:	As received, 2 off panels mounted on a 900 x 450 mm piece of 12 mm thick chip board.	
Joint Width:	N/A	
Air Temperature:	21ºC	
Test Standard:	AS/NZS 4586 - 2004 Slip resistance classification of new pedestrian surface materials – Appendix D.	
Surface Structure :	Ribbed	
Classification Criteria: (TABLE D3 in AS/NZS 4586- 2004)	**Corrected Mean Overall Acceptance Angle**	**Slip Resistance Assessment Group**
	6° to 10°	R9
	Over 10° to 19°	R10
	Over 19° to 27°	R11
	Over 27° to 35°	R12
	Over 35°	R13
Displacement Space:	Not Measured	
Displacement Space Assessment Group:	N/A	
Mean Overall Acceptance Angle:	**18.1°**	
Slip Resistance Assessment Group:	**R10**	

These results apply only to the specimens tested and it is recommended that before selection of flooring or paving materials the effect of service conditions, including maintenance procedures and wear on their slip-resistance be checked.
NOTE: Any specimens supplied will be disposed of in two (2) months time, unless otherwise instructed.

ATTAR

D. Padfield

David Padfield BEng (Mat) Hons.,
Materials Engineer

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CSIRO

Industrial Research Services

Manufacturing & Infrastructure Technology, Graham Road (PO Box 56), Highett, Victoria, Australia 3190
Telephone: 61 3 9252 6000 Facsimile: 61 3 9252 6244 Email: tiles@csiro.au Web: http://www.cmit.csiro.au

Registered Testing Authority - Building Code of Australia

5 June 2006 Our Ref. EN13 / 46 03/0212

TEST REPORT No. 3568s

Requested by:	ATTAR
on (date):	1 June 2006
Manufacturer:	Unknown
Product Desc.:	Thru-Flow Interlocking Panels 1200mm x 600mm
Sampling details:	
Where:	Delivered
Date:	1 June 2006
By whom:	Courier
How (methods):	N/A

The results reported relate only to the sample(s) tested and the information received. No responsibility is taken for the accuracy of the sampling unless it is done under our own supervision. CSIRO cannot accept responsibility for deviations in the manufactured quality and performance of the product. While CSIRO takes care in preparing the reports it provides to clients, it does not warrant that the information in this particular report will be free of errors or omissions or that it will be suitable for the client's purposes. CSIRO will not be responsible for the results of any actions taken by the client or any other person on the basis of the information contained in the report or any opinions expressed in it. The reproduction of this test report is only authorised in the form of a complete photographic facsimile. Our written approval is necessary for any partial reproduction.

This test report consists of 3 pages

SUMMARY OF SLIP RESISTANCE TESTS PERFORMED:

		Result	Class
AS/NZS 4586:2004	Slip resistance classification of new pedestrian surface materials		
	Appendix C: WET/BAREFOOT Ramp		
	Mean angle of inclination:	29°	C

In order to interpret the classifications, please refer to Standards Australia Handbook 197, An Introductory Guide to the Slip Resistance of Pedestrian Surface Materials, which recommends minimum classifications for a wide variety of locations.

It is important to realise that test results obtained on unused factory-fresh samples may not be directly applicable in service, where proprietary surface coatings, contamination, wear and subsequent cleaning all influence the behaviour of the pedestrian surface.

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Telephone: 61 3 9252 6000 Facsimile: 61 3 9252 6244 Email: tiles@csiro.au Web: http://www.cmit.csiro.au

REPORT NO: 3568s
ISSUE DATE: 5 June 2006
MANUFACTURER: Unknown
PRODUCT DESC: Thru-Flow Interlocking Panels
1200mm x 600mm

SLIP RESISTANCE CLASSIFICATION OF NEW PEDESTRIAN SURFACE MATERIALS

WET/BAREFOOT RAMP TEST METHOD

TEST CARRIED OUT IN ACCORDANCE WITH
AS/NZS 4586:2004 (Appendix C)

Test Date: 5 June 2006

.ocation: Slip Resistance Laboratory

Sample Fixed

Joint width: N/A mm

Surface structure:
[ ] Smooth
[ ] Profiled
[X] Structured

RESULTS

		Actual mean	Reported mean
Mean angle of inclination:	**Calibration Board A:**	**11.01 °**	**11 °**
	Calibration Board B:	**17.41 °**	**17 °**
	Calibration Board C:	**26.14 °**	**26 °**
'Iean angle of inclination of Test Board:		**29.31 °**	**29 °**

CLASSIFICATION:

Quality Group: **C**

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Telephone: 61 3 9252 6000 Facsimile: 61 3 9252 6244 Email: tiles@csiro.au Web: http://www.cmit.csiro.au

REPORT NO: 3568s
ISSUE DATE: 5 June 2006
MANUFACTURER: Unknown
TILE DESC: Thru-Flow Interlocking Panels
1200mm x 600mm

Date and Place 5 June 2006, Highett, Vic

Name, Title and Signature:

PETER WESTGATE
Senior Laboratory Technician

Tel: 61 3 92526108
Fax: 61 3 92526244
Email: Peter.Westgate@csiro.au

Consulting services are available if further detailed analysis of the test results are required.

Environmental Reports

City of Seattle
Gregory J. Nickels, Mayor

Department of Planning and Development
D. M. Sugimura, Director

CITY OF SEATTLE
ANALYSIS AND DECISION OF THE DIRECTOR OF
THE DEPARTMENT OF PLANNING AND DEVELOPMENT

Application Number: 3004212 and 3004213

Applicant Name: Gregory Ashley for Barrick Benson

Address of Proposal: 11740 and 11744 Riviera Place Northeast

SUMMARY OF PROPOSED ACTION

Shoreline Substantial Development Permit to construct a 72 foot long, 542 sq. ft. shared residential pier accessory to two single family residences (11740 and 11744 Riviera Pl NE). Existing boatlift to be relocated and a second boatlift to be installed.

The following Master Use Permit components are required:

Shoreline Substantial Development Permit – to allow a shared residential pier in an Urban Residential (UR)/Conservancy Recreation (CR) Shoreline Environment – (Sections 23.60.540 and 23.60.362, Seattle Municipal Code)

SEPA - Environmental Determination - (Seattle Municipal Code (SMC) 25.05)

SEPA DETERMINATION: [ ] Exempt [X] DNS [ ] MDNS [ ] EIS

[X] DNS with conditions

[ ] DNS involving non-exempt grading or demolition or, involving another agency with jurisdiction.

BACKGROUND DATA

Existing Conditions

Both subject sites (11740 and 11744 Riviera Place Northeast) are located east of Riviera Place Northeast along Lake Washington. The properties are zoned Single Family 5000 (SF 5000) within the Urban Residential/Conservancy Recreation (UR/CR) Shoreline Master Program designations. The lots are rectangular in shape with the long axis of each lot running almost 180' between Riviera Place Northeast and the inner harbor line of Lake Washington. Both sites slope

downward approximately 7' from the street front towards the lake with a generally flat area near the shore. One single family residence resides on each property. An existing hydraulic boat lift is situated approximately 7' offshore and adjacent to that portion of the bulkhead that located on the property addressed as 11744 Riviera Place Northeast.

Area Development

Properties north and south of the subject sites consist of single family residences with accessory piers. The Burke Gilman Trail and single family residences are located west of Riviera Place Northeast and upland from the subject sites.

The shoreward side (east) of Riviera Place Northeast is zoned SF 5000 UR/CR. Conversely, the landward side (west) of Riviera Place Northeast is zoned SF 5000 UR and SF 7200 UR.

Proposal

The applicant proposes to construct a new shared pier accessory to two existing single family residences located at 11740 and 11744 Riviera Place Northeast. The proposed pier would be attached to an existing vertical metal sheet pile bulkhead and equally straddle the boundary line between the two properties. The new shared pier would have a total area of 542 square feet (sq. ft.) and extend entirely over water at a distance of 72' from the bulkhead. This "T" shaped pier will be 4' in width for the first 20', increase to 6' in width and have an 8' by 24' configuration at the eastern end of the pier. A total of fourteen (14) supporting steel piles will be installed supporting decking comprised of "Thru-Flow" grating. The bottom of the new pier would be 1.5' above the ordinary high water (OHW) mark. The existing hydraulic boatlift will be relocated and a second hydraulic boatlift will be installed on the opposite side of the pier.

Public Comment

The public comment period for both projects ended April 14, 2006. During the public comment period, DPD received no written comments regarding these proposals.

ANALYSIS - SHORELINE SUBSTANTIAL DEVELOPMENT PERMIT

Substantial Development Permit Required

Section 23.60.030 of the Seattle Municipal Code provides criteria for review of a shoreline substantial development permit and reads: *A substantial development permit shall be issued only when the development proposed is consistent with:*

A. The policies and procedures of Chapter 90.58 RCW;

B. The regulations of this Chapter; and

C. The provisions of Chapter 173-27 WAC.

Conditions may be attached to the approval of a permit as necessary to assure consistency of the proposed development with the Seattle Shoreline Master Program and the Shoreline Management Act.

A. THE POLICIES AND PROCEDURES OF CHAPTER 90.58.RCW

Chapter 90.58 RCW is known as the Shoreline Management Act of 1971. It is the policy of the State to provide for the management of the shorelines of the state by planning for and fostering all reasonable and appropriate uses. This policy contemplates protecting against effects to public health, the land use and its vegetation and wild life, and the waters of the state and their aquatic life, while protecting public right to navigation and corollary incidental rights. Permitted uses in the shoreline shall be designed and conducted in a manner to minimize, insofar as possible, any resultant damage to the ecology and environment of the shoreline area and any interference with the public's use of the water.

The Shoreline Management Act provides definitions and concepts, and gives primary responsibility for initiating and administering the regulatory program of the Act to local governments. The Department of Ecology is to primarily act in a supportive and review capacity, with primary emphasis on insuring compliance with the policy and provisions of the Act. As a result of this Act, the City of Seattle and other jurisdictions with shorelines, adopted a local shoreline master program, codified in the Seattle Municipal Code at Chapter 23.60.

Development on the shorelines of the state is not to be undertaken unless it is consistent with the policies and provisions of the Act, and with the local master program. The Act sets out procedures, such as public notice and appeal requirements, and penalties for violating its provisions.

The proposal is subject to the Shoreline Policies of SMC 23.60.004 because the sites are located within the shoreline district and the cost of the project exceeds $5000.

The proposed shared residential pier with attached hydraulic boatlifts has been designed to ensure minimum impact to the public health, land, and the waters of the state, and their aquatic life. The layout of the shared residential pier will not interfere with the public rights of navigation and corollary rights, thus providing for the management of the shorelines by planning for and fostering all reasonable and appropriate uses. Therefore, the subject application is consistent with the procedures outlined in RCW 90.58.

B. THE REGULATIONS OF CHAPTER 23.60

Chapter 23.60 of the Seattle Municipal Code is known as the "Seattle Shoreline Master Program". In evaluating requests for substantial development permits, the Director must determine that a proposed use meets the approval criteria set forth in SMC 23.60.030 (cited above). Development standards of the shoreline environment and underlying zone must be considered, and a determination made as to any special requirements (shoreline conditional use, shoreline variance, or shoreline special requirements use permit) or conditioning that is necessary to protect and enhance the shorelines area (SMC 23.60.064).

Pursuant to SMC 23.60.064C, in evaluating whether a development which requires a substantial development permit, conditional use permit, variance permit or special use authorization meets the applicable criteria, the Director shall determine that the proposed use: 1) is not prohibited in the shoreline environment and the underlying zone and; 2) meets all applicable development standards of both the shoreline environment and underlying zone and; 3) satisfies the criteria for a shoreline variance, conditional use, and/or special use permits, if required.

SMC 23.60.004 - Shoreline Policies

The Shoreline Goals and Policies which are part of the Seattle Comprehensive Plan's Land Use Element and the purpose and locational criteria for each shoreline environment designation contained in SMC 23.60.220 must be considered in making all discretionary decisions in the shoreline district.

Both sites are classified as a waterfront lots (SMC 23.60.924). The shoreline designations for the site are Urban Residential/Conservancy Recreation (UR/CR) (SMC 23.60.540 and 23.60.360). Residential piers are a permitted use in these shoreline environments.

Development Standards

The proposal to construct a shared residential pier with attached hydraulic boatlifts that straddles the boundary line of two (2) residential properties is permitted outright in SMC 23.60.362 governing the CR shoreline environment. The proposed action is therefore subject to:

1. *the general development standards for all shoreline environments (SSMP 23.60.152);*
2. *the development standards for uses in the UR and CR environments (SSMP 23.60.570 and 23.60.390);*
3. *the development standards for piers and floats accessory to residential development (SSMP 23.60.204); as well as*
4. *the development standards for Single Family zones (SMC 23.44).*

1. General Development Standards for all Shoreline Environments (SSMP 23.60.152)

These general standards apply to all uses in the shoreline environments. They require that all shoreline activity be designed, constructed, and operated in an environmentally sound manner consistent with the Shoreline Master Program and with best management practices for the specific use or activity, in order to prevent degradation of land or water. All shoreline development and uses must: 1) minimize and control any increases in surface water runoff so that receiving water quality and shore properties are not adversely affected; 2) be located, designed, constructed, and managed in a manner that minimizes adverse impacts to surrounding land and water uses and is compatible with the affected area; and 3) be located, constructed, and operated so as not to be a hazard to public health and safety.

The proposed project's design as conditioned is consistent with these general standards for development within the shoreline area, thereby minimizing any adverse impact to the shoreline area, to water quality and will not be a hazard to the public health and safety.

2. Development Standards for UR and CR Shoreline Environments (SSMP 23.60.570 and 23.60.390)

The development standard for the UR and CR environments pertinent to this proposal concerns lot coverage of all structures, including piers. The CR environment development standards also contain requirements for natural area protection.

The lot coverage regulations for both shoreline environments require that structures, including piers, not occupy an area greater than thirty-five (35) percent of a waterfront lot. Under the proposal, total lot coverage would be approximately 1,621 sq. ft. for the property addressed as 11744 Rivera Place Northeast and 1,397 sq. ft. for the property addressed as 11740 Riviera Place Northeast. Each subject lot's area is 5,400 sq. ft. Hence, lot coverage meets the requirements.

Natural area protection of the CR environment requires that all developments in this environment be located and designed to minimize adverse impacts to natural areas of biological significance and that development in critical natural areas be minimized. Critical areas include fish spawning areas and migration routes. The biological evaluation prepared by EcoPacific Environmental Services (dated February 17, 2006) evaluated both sites and determined, "the proposed project conforms as close as is practicable to RGP3," and believes it "warrants a '*not likely to adversely effect'* determination for ESA listed species in the area (i.e., salmon, bull trout, and bald eagles) and associated critical habitat". Design elements of the project have minimized the adverse impacts on the shoreline environment including fish spawning areas and fish migration routes. These design elements included the following:

1. Installing decking material (Otron ThruFlow dock panels) that would ensure minimal shading effect.
2. Placing the bottom of the new pier 1.5' above OHW to increase the amount of light that reaches underneath the pier.
3. Installing new 8" steel piles at least 18' apart along the main walkway in order to minimize impacts to Endangered Species Act (ESA) fish species due to modification of shallow habitats of the species or their predators.

3. <u>Development Standards for Piers and Floats Accessory to Residential Development (SSMP 23.60.204)</u>

These standards apply to residential development in the shoreline environment. The standards specify the size and location of piers and floats. Piers should be located generally parallel to side lot lines and perpendicular to the shoreline and the proposed pier would be consistent with this code requirement. The pier will be located within 15' of the side lot lines because it is a shared pier. The owners of both subject properties have submitted a joint use and maintenance agreement. The combined total width of the subject lots is exactly 60'. The proposed pier is 72' in length and will be less than the maximum 100' allowed from the shoreline and not beyond the length of the neighboring piers. The 8'by 24' pier extension will not exceed 150 sq. ft. allowed per each residence for shared piers. The proposed two boatlifts are in scale with the proposed shared pier. For these reasons, the proposed residential shared pier will be consistent with the code requirements for piers accessory to residential development.

4. <u>General Development Standards for Single Family Zone Uses (23.44 SMC)</u>

SMC 23.44.008 states that the development standards set out in this subchapter apply to principal and accessory uses permitted outright in single-family zones. The proposed shared pier is accessory to the single family residences and not a principal use which is not allowed outright in the zone. Therefore, the residential development complies with this code section.

C. THE PROVISIONS OF CHAPTER 173-27 WAC

WAC 173-27 establishes basic rules for the permit system to be adopted by local governments, pursuant to the language of RCW 90.58. It provides the framework for permits to be administered by local governments, including time requirements of permits, revisions to permits, notice of application, formats for permits, and provisions for review by the state's Department of Ecology (DOE). As the Seattle Shoreline Master Program has been approved by DOE, consistency with the criteria and procedures of the SMC Chapter 23.60 is also consistency with WAC 173-27 and RCW 90.58.

Summary

Development requiring a Shoreline Substantial Development Permit can only be approved if it conforms to the policies and procedures of the WAC and RCW and with the regulations of Chapter 23.60 of the Seattle Shoreline Master Program.

The project as conditionally proposed meets the specific standards for development in the CR environment. It also conforms to the general development standards, as well as the requirements of the underlying zone, therefore it should be approved.

Pursuant to the Director's authority under Seattle's Shoreline Master Program, to ensure that development proposals are consistent with the polices and procedures, and conforms with specific development standards of the underlying zones, and having established that the proposed use and development are consistent with the Seattle Shoreline Program, the proposal, as conditioned below, is hereby approved.

DECISION - SHORELINE SUBSTANTIAL DEVELOPMENT PERMIT

The Shoreline Substantial Development Permit is **CONDITIONALLY GRANTED** subject to the conditions listed at the end of this report.

ANALYSIS - SEPA

The initial disclosure of the potential impacts from this project was made in the environmental checklist submitted by the applicant dated February 22, 2006. The information in the checklist and the experience of the lead agency with review of similar projects form the basis for this analysis and decision.

The SEPA Overview Policy (SSMC 25.05.665 D) clarifies the relationship between codes, policies, and environmental review. Specific policies for each element of the environment, certain neighborhood plans, and other policies explicitly referenced may serve as the basis for exercising substantive SEPA authority.

The Overview Policy states in part: *"where City regulations have been adopted to address an environmental impact, it shall be presumed that such regulations are adequate to achieve sufficient mitigation,"* subject to some limitations. Under such limitations/circumstances (SSMC 25.05.665 D1-7) mitigation can be considered. Thus, a more detailed discussion of some of the impacts is appropriate.

Short-term Impacts

The following temporary or construction related impacts are expected: water impacts (disturbance of migrating fish by sedimentation and clouding due to pile driving); 2) noise impacts (also due to pile driving). These impacts are not considered significant because they are temporary (SMC Section 25.05.794). Although not significant, the impacts are adverse and certain mitigation measures are appropriate as specified below.

Water Impacts

Construction impacts to the lake environment will be mitigated by construction company procedures and the Washington Department of Fish and Wildlife's restriction on construction times. Specifically, all construction work will occur from a floating barge, there will be no equipment on the shoreline, and the barge will not be grounded.

Noise Impacts

Noise impacts associated with pile driving would likely affect resident fish on Lake Washington. Due to this disturbance, the limitations of the Noise Ordinance are found to be inadequate to mitigate the potential noise impacts. SEPA Overview Policy (SMC 25.05.675 B) allows further mitigation for habitat disruption caused by construction noise and is warranted.

Compliance with these applicable policies and ordinances will be adequate to achieve sufficient mitigation and further mitigation by imposing specific conditions is not necessary for these impacts. Other city codes and/or ordinances apply to the proposal and will provide mitigation for the environmental health impacts.

Underwater Habitat

Minimum disturbance of the lake sediments is expected since most work will be done above water. There is the potential for construction debris to enter the water during construction, so care will have to be taken to prevent this from occurring. In addition to the requirements set forth by SSMP 23.60.152, the general recommendations from Metro shall also be followed as conditioned below.

Long-term Impacts

Plants and Animals

Chinook salmon, a species listed as threatened under the Endangered Species Act (ESA) in March 1999, are known to inhabit Lake Washington including the proposed project area. Under the City of Seattle's Environmental Policies and Procedures 25.05.675 N (2) it states in part: *A high priority shall also be given to meeting the needs of state and federal threatened, endangered, and sensitive species of both plants and animals.*

This project is proposed to take place in Lake Washington, which is rearing habitat and is part of the migration corridor of Chinook salmon from the Cedar River and the other water bodies in Water Resource Inventory Area 8.

Clearly identified long-term impacts on juvenile Chinook salmon and the aquatic environment include the continued existence of a bulkhead, an increase in over-water coverage and the presence of piles in the habitat of a threatened species. Over-water coverage and piles impact the quality of natural habitat of juvenile Chinook salmon by creating shading and providing structure for small mouth bass. Additionally, bulkheads tend to create deeper water habitat caused by erosion and water action at the bulkhead. When juvenile Chinook have no shallow water habitat, which provides refuge from predators, during their out-migration they are more susceptible to predation by larger fish; therefore, this decreases their survival.

As provided by SMC 25.05.350 A, when making a threshold determination the lead agency may consider mitigation measures that the agency or applicant will implement. Proposed mitigation measures may allow the lead agency to issue a Determination of Non-Significance (DNS). These mitigation measures can be in the form of clarification of the proposal, changes to the proposal, or the project may be conditioned to include the mitigation measures. The applicant has included mitigation measures in the project to offset the impacts of the proposed work and DPD has imposed conditions on this project. These mitigation measures and conditions are listed below.

1. Installing decking material (Otron ThruFlow dock panels) that would ensure minimal shading effect.
2. Placing the bottom of the new pier 1.5' above OHW to increase the amount of light that reaches underneath the pier.
3. Installing new 8" steel piles at least 18' apart along the main walkway in order to minimize impacts to Endangered Species Act (ESA) fish species due to modification of shallow habitats of the species or their predators.
4. Install a total of eight (8) planters (four (4) planters per residence) containing native shrubs along the existing bulkhead.

Each of these mitigation measures and conditions are believed to minimize impacts on juvenile salmon habitat at the site and improve the aquatic habitat for juvenile Chinook salmon and other species. Collectively these measures will eliminate the dark areas that may exist under the dock and eliminate structure in the shallow water habitat, which should in turn allow the juvenile salmon to remain in the shallow water during their migration and reduce the juvenile Chinooks' vulnerability to predation. Locating the bulkhead at or above OHW will minimize impact of the bulkhead caused by wave action. Additionally, terrestrial vegetation adds detritus material to the aquatic environment, which benefits the salmon through the food web. Terrestrial vegetation also directly benefits salmon by providing a food source in the form of terrestrial insects that drop into the water. Therefore, the riparian vegetation planted along the shoreline will increase the allocation of insects and detritus to the aquatic environment providing food for juvenile salmon and nutrients for other aquatic organisms.

Summary

In conclusion, several effects on the environment may result from the proposed development. However, by following the proposed mitigation measure, these effects will not be significant. The conditions imposed at the end of this report are intended to mitigate specific impacts identified in the foregoing analysis, to control impacts not adequately regulated by codes or ordinances, per adopted City policies.

DECISION - SEPA

This decision was made after review by the responsible official on behalf of the lead agency of a completed environmental checklist and other information on file with the responsible department. This constitutes the Threshold Determination and form. The intent of this declaration is to satisfy the requirements of the State Environmental Policy Act (RCW 43.21.C), including the requirement to inform the public of agency decisions pursuant to SEPA.

[X] Determination of Non-Significance. This proposal has been determined to not have a significant adverse impact upon the environment. An EIS is not required under RCW 43.21C.030(2)(C).

[ ] Determination of Significance. This proposal has or may have a significant adverse impact upon the environment. An EIS is required under RCW 43.21C.030(2)(C).

SEPA AND SHORELINE CONDITIONS

The following conditions to be enforced during construction shall be posted at the site in a location on the property line that is visible and accessible to the public and to construction personnel from the street right-of-way. If more than one street abuts the site, conditions shall be posted at each street. The conditions will be affixed to placards prepared by DPD. The placards will be issued along with the building permit set of plans. The placards shall be laminated with clear plastic or other waterproofing material and shall remain posted on-site for the duration of the construction.

Prior to Issuance of a Construction Permit

The owner(s) and/or responsible party(s) shall:

1. Develop a Best Management Practices (BMP) Plan to be included on the plan set. The BMP plan shall indicate how construction will take place to ensure that no debris or deleterious material shall enter the water through the duration of the proposed work.

2. Spill prevention and response procedures shall be developed prior to commencement of construction and the appropriate material shall be kept at the site for quick response to any toxic spills, such as fuel, at the site. This information shall be provided on the construction plan set.

3. Install a total of eight (8) planters (four (4) planters per residence) containing native shrubs along the existing bulkhead. The planter size, genius/species name and location should be included on the plan set.

Prior to Commencement of Construction

4. No toxic materials, petrochemicals and other pollutants shall enter the surface water during the proposed construction work. The spill prevention and response procedures developed for this project shall be followed and the appropriate material shall be kept at the site for quick response to any toxic spills, such as fuel, at the site.

5. Personnel shall be trained in the plans and procedures for the prevention, containment and clean-up of toxic material.

During Construction

6. The owner(s), builder(s), or responsible party(s) shall follow the Best Management Practices and the Emergency Containment plans developed to prevent debris and other deleterious material from entering the water during construction.

    a. If floating debris enters the water during the proposed work this debris shall be removed immediately and stored until it can be disposed of at an appropriate upland facility.
    b. If heavy (sinking) debris enters the water during the proposed work the location of the debris shall be documented in a log that is kept on site for the duration of the construction work. When construction is complete a diver shall retrieve all debris that has entered the water and sunk during the proposed work.

7. Equipment using oil, gasoline, or diesel used on site shall be checked daily for evidence of leakage, if evidence of leakage is found, further use of such equipment shall be suspended until the deficiency has been satisfactorily corrected.

8. No treated wood shall be used in the decking material.

9. No fascia shall be installed because it blocks natural light from reaching under the pier.

10. Grating of the deck of the pier shall occur per plans.

11. If treated wood is proposed for other structures, this wood shall be professionally treated and completely cured using the best management practices developed by the Western Wood Preservers Institute (http://www.wwpinstitute.org/) before this wood is used for this project.

12. Equipment for the transportation, storage, handling and application of oil, chemicals, or other hazardous materials shall be maintained in a safe and leak-proof condition to prevent release of this material into the water.

For the Life of the Project

13. The shrubs planted in the planters shall be maintained and shall be replaced at a one to one ratio for any plants that do not survive. Replacement plants shall be native plants of a similar type.

14. The deck surface shall remain unobstructed and the grates shall remain free of debris so that light can pass through the open areas of the deck.

Signature: (signature on file) Date: July 10, 2006
Tamara Garrett, Land Use Planner
Department of Planning and Development

TG:ga
I:\garrett\DOC\Shoreline\ 3004212 and 3004213 decision.doc

Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation (SAV), Marsh or Mangrove Habitat
U.S. Army Corps of Engineers/National Marine Fisheries Service
August 2001

Submerged Aquatic Vegetation:

1. Avoidance. The pier shall be aligned so as to minimize the size of the footprint over SAV beds.

2. The height of pier shall be a minimum of 5 feet above MHW/OHW as measured from the top surface of the decking.

3. The width of the pier is limited to a maximum of 4 feet. A turnaround area is allowed for piers greater than 200 feet in length. The turnaround is limited to a section of the pier no more than 10 feet in length and no more than 6 feet in width. The turnaround shall be located at the midpoint of the pier.

4. Over-SAV bed portions of the pier shall be oriented in a north-south orientation to the maximum extent that is practicable.

5. a. If possible, terminal platforms shall be placed in deep water, waterward of SAV beds or in an area devoid of SAV beds.

b. If a terminal platform is placed over SAV areas and constructed of grated decking, the total size of the platform shall be limited to 160 square feet. The grated deck material shall conform to the specifications stipulated below. The configuration of the platform shall be a maximum of 8 feet by 20 feet. A minimum of 5 feet by 20 feet shall conform to the 5-foot height requirement; a 3 feet by 20 feet section may be placed 3 feet above MHW to facilitate boat access. The long axis of the platform should be aligned in a north-south direction to the maximum extent that is practicable.

c. If the terminal platform is placed over SAV areas and constructed of planks, the total size of the platform shall be limited to 120 square feet. The configuration of the platform shall be a maximum of 6 feet by 20 feet of which a minimum 4-foot wide by 20-foot long section shall conform to the 5-foot height requirement. A section may be placed 3 feet above MHW to facilitate boat access. The 3 feet above MHW section shall be cantilevered. The long axis of the platform should be aligned in a north-south direction to the maximum extent that is practicable. If the 3feet above MHW section is constructed with grating material, it may be 3 feet wide.

6. One uncovered boat lift area is allowed. A narrow catwalk (2 feet wide if planks are used, 3 feet wide if grating is used) may be added to facilitate boat maintenance along the outboard side of the boat lift and a 4-foot wide walkway may be added along the stern end of the boat lift, provided all such walkways are elevated 5 feet above MHW. The catwalk shall be cantilevered from the outboard mooring pilings (spaced no closer than 10 feet apart).

7. Pilings shall be installed in a manner which will not result in the formation of sedimentary deposits("donuts" or "halos") around the newly installed pilings. Pile driving is the preferred method of installation, but jetting with a low pressure pump may be used.

8. The spacing of pilings through SAV beds shall be a minimum of 10 feet on center.

9. The gaps between deckboards shall be a minimum of ½ inch.

Grid Specifications and Suppliers Section modified in October 2002 to add an additional vendor of materials.
February 2003 -Vendor name changed from ChemGrate to FiberGrate

Marsh:

1. The structure shall be aligned so as to have the smallest over-marsh footprint as practicable.

2. The over-marsh portion of the dock shall be elevated to at least 4 feet above the marsh floor.

3. The width of the dock is limited to a maximum of 4 feet. Any exceptions to the width must be accompanied by an equal increase in height requirement.

Mangroves.

1. The width of the dock is limited to a maximum of 4 feet.

2. Mangrove clearing is restricted to the width of the pier.

3. The location and alignment of the pier should be through the narrowest area of the mangrove fringe.

Grid Specifications and Suppliers

The following information does not constitute a U.S. Army Corps of Engineers endorsement or advertisement for any particular provider and is provided only as an example for those interested in obtaining these materials for dock construction. A type of fiberglass grate panel is manufactured by SeaSafe (Lafayette, LA; phone: 1-800-326-8842) and FiberGrate (1-800-527-4043). Plastic grate panels are also available from Southern Pine Lumber Company (Stuart, FL; phone: 772-692-2300). Panels are available in a variety of sizes and thicknesses. For safety, the grate should contain an anti-slip texture which is integrally molded into the top surface. The manufacturer or local distributor should be consulted to ensure that the load-bearing capacity of the selected product is sufficient to support the intended purpose. Contact the manufacturer(s) for product specifications and a list of regional distributors.

Grid Specifications and Suppliers Section modified in October 2002 to add an additional vendor of materials.
February 2003 -Vendor name changed from ChemGrate to FiberGrate

Key[1] for Construction Conditions for Docks or Other Minor Structures Constructed in or Over Johnson's Seagrass (*Halophila johnsonii*)
National Marine Fisheries Service/U.S. Army Corps of Engineers
October 2002

1a. The construction site is within the known range of Johnson's seagrass occurrence (Sebastian Inlet to central Biscayne Bay in the lagoonal systems on the east coast of Florida). *Go to 2*.

1b. The construction site is not within the known range of Johnson's seagrass occurrence but submerged aquatic vegetation (SAV) is present at the site. Use *"Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat" - U.S. Army Corps of Engineers/National Marine Fisheries Service, August 2001.*

1c. The construction site is not within the range of Johnson's seagrass and SAV is not present at the site: *No construction conditions for SAV are necessary.*

2a. Seagrass survey for Johnson's seagrass is performed at the proposed site during the April 1 – August 31 growing season. *Go to 3.*

2b. No survey for Johnson's seagrass is performed at the proposed site during the growing season, or a survey is performed at the proposed site but is outside of the growing season. *Go to 4.*

3a. Johnson's seagrass is present at the proposed construction site. *Go to 5.*

3b. Johnson's seagrass is not present at the proposed construction site. *Go to 6.*

4a. The construction is in an area designated by the National Marine Fisheries Service - Protected Resources Division (NMFS-PRD) as **critical habitat[2]** for Johnson's seagrass. Use *"Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat" - U.S. Army Corps of Engineers/National Marine Fisheries Service, August 2001,* ***except that light-transmitting materials[2] (LTMs) shall comprise 100% of all pedestrian surfaces waterward of the mean low water (MLW) line.***

4b. The construction is not in an area designated by NMFS-PRD as critical habitat for Johnson's seagrass. Use *"Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat" - U.S. Army Corps of Engineers/National Marine Fisheries Service, August 2001,* ***except that LTMs shall comprise at least 75% of all pedestrian surfaces waterward of the MLW line and a minimum 1-inch spacing shall be maintained between all wooden deckboards used waterward of the MLW line.***

5a. The construction is in an area designated by NMFS-PRD as critical habitat for Johnson's seagrass. Use *"Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat" - U.S. Army Corps of Engineers/National Marine Fisheries Service, August 2001,* ***except that LTMs shall comprise at least 75% of all pedestrian surfaces waterward of the MLW line and a minimum 1-inch spacing shall be maintained between all wooden deckboards used waterward of the MLW line.***

5b. The construction is not in an area designated by NMFS-PRD as critical habitat for Johnson's seagrass. Use *"Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat" - U.S. Army Corps of Engineers/National Marine Fisheries Service, August 2001,* ***except that all pedestrian surfaces directly over Johnson's seagrass areas shall be constructed of LTMs and a minimum***

This key was modified in October 2002 to change the percent light transmittance requirement of the grids from 46 to 43 as stipulated in Note #3 .

1-inch spacing shall be maintained between all wooden deckboards used waterward of the MLW line.

6a. The construction is in an area designated by NMFS-PRD as critical habitat for Johnson's seagrass. *Use "Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat" - U.S. Army Corps of Engineers/National Marine Fisheries Service, August 2001,* ***except that a minimum 1-inch spacing shall be maintained between all wooden deckboards used waterward of the MLW line.***

6b. The construction is not in an area designated by NMFS as critical habitat for Johnson's seagrass. *Go to 7*

7a. SAV other than Johnson's seagrass is present at the site. *Use "Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat" - U.S. Army Corps of Engineers/National Marine Fisheries Service, August 2001.*

7b. No SAV present. *No construction conditions for SAV are necessary.*

Notes:

[1.] This key is meant to complement but not supersede the *"Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation, Marsh or Mangrove Habitat - U.S. Army Corps of Engineers/National Marine Fisheries Service, August 2001.* **Docks incorporating light-transmitting materials shall not exceed the dimensions recommended in the Guidelines.**

[2.] Federal Register 65 FR 17786, April 5, 2000, Designation of critical habitat for Johnson's seagrass.

[3.] Light-transmitting materials are made of various materials shaped in the form of grids, grates, lattices, etc., to allow the passage of light through the open spaces. **All light-transmitting materials used for dock construction in the known range of Johnson's seagrass shall have a minimum of forty-three (43) percent open space.**

This key was modified in October 2002 to change the percent light transmittance requirement of the grids from 46 to 43 as stipulated in Note #3 .

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Preliminary Results of Light Transmission under Residential Piers in Lake Washington, King County, Washington: A Comparison between Prisms and Grating

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Abstract

Gayaldo, P.F. and K. Nelson. 2006. Preliminary results of light transmission under residential piers in Lake Washington, King County, Washington: A comparison between prisms and grating. Lake and Reserv. Manage. 22(3):245-249.

During the summers of 2003 and 2004, 11 piers (two public and nine private) were evaluated for their ability to transmit light through the decking to the water surface below. Solid decking produces distinct shading that migrating juvenile Chinook salmon appear to avoid by swimming into deeper water where more potential predators live. Two new types of surface treatments (acrylic prisms and grating) were evaluated and compared to traditionally spaced decking as well as solid decking. Grating (with 37-58% open space) was found to transmit significantly more light to the water surface below (mean = 7.5% of full sunlight) than 23 x 5 cm acrylic prisms (mean = 0.7% of full sunlight). In other words, compared to full sunlight, grating transmits 10 times more light under the pier than acrylic prisms. In addition, light that passes through open grating penetrates the water evenly under the pier. Light transmitted through prisms concentrates beams of light that do not always reach the water surface.

Key Words: deck spacing, grating, light transmission, pier, prisms, salmon, shading

On March 24, 1999, Chinook salmon (*Oncorhynchus tshawytscha*) in the Puget Sound region were listed as threatened under the Endangered Species Act (ESA or the Act). Primary concerns for juvenile Chinook salmon regarding new and remodeled piers in Lake Washington include habitat changes in the nearshore from pier shade and structure, shoreline modifications to build and access the piers, and degradation of water quality from pier construction and use. Shade from piers is caused by the decking, pilings and support structures and attached floats and may provide predatory fish some advantage in capturing prey. Helfman (1981) found that fish hovering in shade could see approaching objects better and were themselves more difficult to see. Tabor *et al.* (2004) found that cottids preyed most effectively on sockeye salmon (*O. nerka*) in complete darkness, and that the lowest predation occurred at the brightest light intensity.

When juvenile Chinook salmon are very small, they use over-water cover (including piers and overhanging vegetation) during the day. As they grow larger, they seem to avoid over-water structure during both the day and night (Tabor and Piaskowski 2001). As juvenile Chinook salmon increase in size they appear to progressively reduce their use of overhead structure.

During the late spring or early summer, juvenile Chinook salmon form small schools of approximately 50-200 fish and begin migrating along the shoreline. Juvenile Chinook salmon have usually been observed in water 1.5-3 m deep and 10-20 m from shore. At Stan Sayres Park in Seattle, Washington, Tabor and Piaskowski (2001) observed schools of out-migrating juvenile Chinook salmon swimming around piers rather than under them, presumably because of the change in light condition. On several days in June 2003 and

2004, Tabor *et al.* (2006) observed numerous schools of migrating Chinook salmon move to slightly deeper water before swimming under piers or around the pier or turning around and swimming away from the pier.

Abrupt transitions from light to dark can cause juvenile Chinook salmon to alter their migration pathway from the nearshore to deeper water or avoid the pier altogether (Tabor *et al.* 2004). Migration through deeper water could expose juvenile Chinook salmon to more predation in addition to lengthening the migration period. Minimizing the effects of shading is expected to be beneficial to juvenile Chinook salmon. This report evaluates the amount of light transmitted through residential piers by comparing different pier surfaces, including solid decking, 50% open space grating and acrylic prisms. Observations of other design features that affect light transmission under piers are also discussed briefly.

As of 2000, approximately 2,737 residential piers have been built in Lake Washington, an average of one pier every 49 m of shoreline (Toft 2001). Because of continuing development pressure, the potential effects of additional over-water structures to juvenile Chinook salmon continue to increase. In addition, the aggregate effects of new and remodeled pier structures on Chinook salmon migration behavior are not known.

Materials and Methods

We surveyed nine private residential piers (Brooks/Hart, Captain, Flint, Galanti, Gasparina, Ling, Olsen, Peters, and Skuja) and two public piers (McClelland and Stan Sayres) located in Lake Washington (Figure 1; Table 1). In June 2003 and July 2004, we measured photosynthetically active radiation (PAR; 400-700 nm) beneath and adjacent to the selected piers (paired samples). The wavelengths of PAR adequately represent those viewed by juvenile salmon (Flamarique 2002 and W. Dickoff, personal communication). We measured light transmitted through four surface treatment types:

1. acrylic prisms – 23 x 5 cm acrylic, rectangular deck prisms at typical installation densities of 1-3 per 33 m^2 (Figure 2).
2. grating – classified into three types (percentage represents open space):
    a. 37.5% open – ThruFlow® high density polyethylene interlocking panels (Figure 3),
    b. 50% open – ironwood grating consisting of 1-in board width and 1-in wide open space (Figure 4), and
    c. 58% open – Chemgrate® molded fiberglass resin (Figure 5).
3. traditional decking – 14-25 cm wide wooden boards spaced 0.7-2 cm (Figure 6).
4. solid decking (control conditions) – each above treatment covered with a canvas tarp 1.2 m long and extending the entire width of the selected pier (Figure 7).

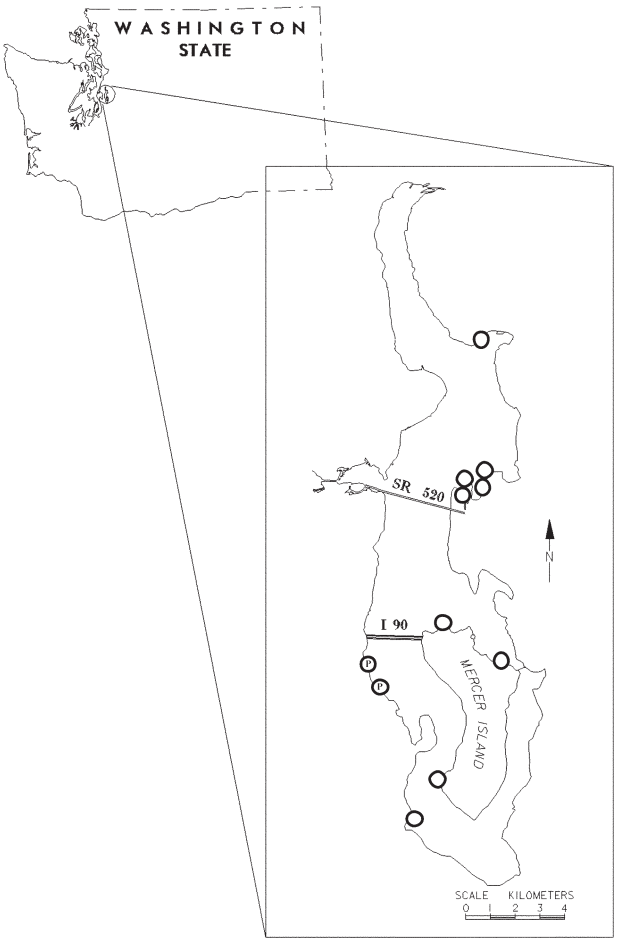

Figure 1.-Location (circles) of piers used to examine the effect of light transmittance, Lake Washington, 2003 and 2004. "P" indicates a public pier; others are private.

A LI-COR LI-190SA quantum sensor was held under each pier to measure the ambient light (PAR) in micromoles of quanta per second per square meter ($\mu mol\ s^{-1}m^{-2}$) at the water surface. We moved the sensor in a circular motion (approximately 0.5 m radius) at the water surface directly beneath prism, grating or decking for a period of 10 sec to obtain an averaged light measurement for each treatment. Immediately following each under-pier measurement, the technique was repeated in full sunlight adjacent to the pier to calculate the percentage of full sunlight available for each surface treatment. The circular motion and 10-sec averaging techniques

Table 1.-List of piers and their respective treatments. Paired readings included a light measurement beneath a treatment type followed immediately by a measurement in full daylight.

Site	# of Paired Readings	Measured Treatment
Brooks/Hart	6	- covered/solid decking (control)
	6	- prisms
Captain	18	- grated decking (50 percent)
Flint	9	- traditional decking
Galanti	9	- covered/solid decking (control)
	12	- traditional decking
	19	- grated decking (50 percent)
	33	- prisms
Gasparina	3	- traditional decking
	3	- prisms
Ling	3	- covered/solid decking (control)
	9	- grated decking (50 percent)
	6	- grated decking (50 percent) shaded by temporary items (*e.g.*, kayaks)
	3	- prisms
McClelland (*public*)	37	- traditional decking without pier skirting
Olsen	7	- grated decking (37.5 percent)
	4	- grated decking (50 percent) shaded by temporary items (*e.g.*, kayaks)
	3	- prisms
Peters	9	- traditional decking
	9	- grated decking (37.5 percent)
	9	- prisms
Skuja	13	- grated decking (58 percent)
Stan Sayres (*public*)	9	- traditional decking

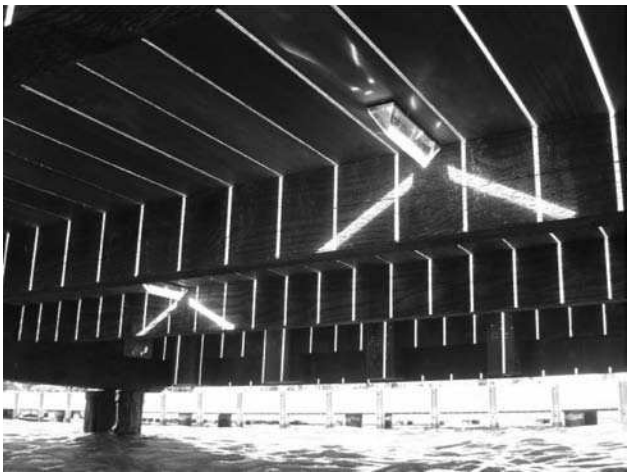

Figure 2.-Acrylic prisms.

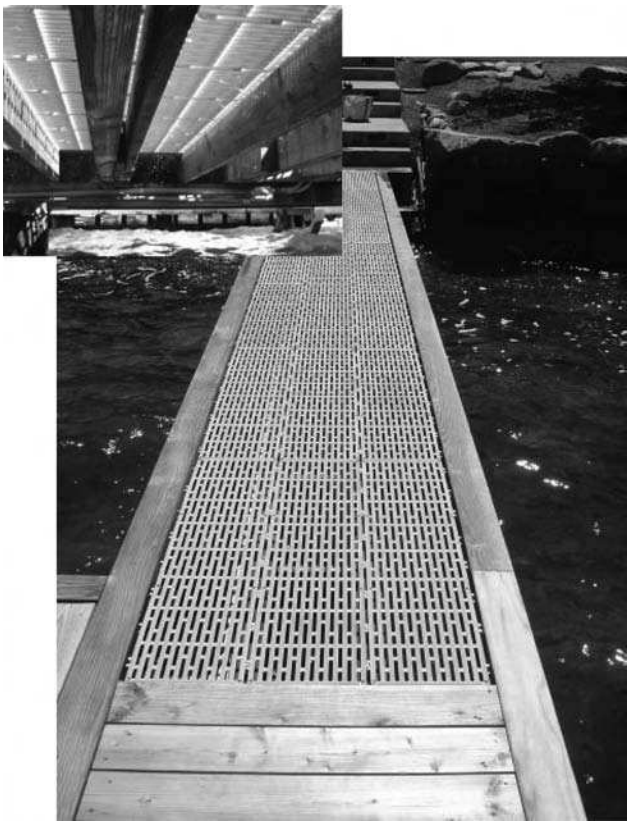

Figure 3.-37.5% open-spaced grating (ThruFlow®).

were used to minimize the sensor variation between direct and indirect sunlight beneath the pier.

A single factor analysis of variance (ANOVA) experimental design (effect of decking treatment on light transmission) was used, followed by the Tukey *a posteriori* test of multiple comparisons (modified for unequal samples sizes within treatments) to identify significant differences ($\alpha = 0.05$) of means between treatments (Zar 1984).

In addition to light measurements, secondary variables were measured, consisting of pier orientation, minimum height of pier above the waterline, sun angle, and shade created by the semi-temporary placement of personal items on the deck surface (*e.g.*, kayaks, storage lockers). Anecdotal (nonstatistical) comparisons of these variables were made and are presented in the discussion.

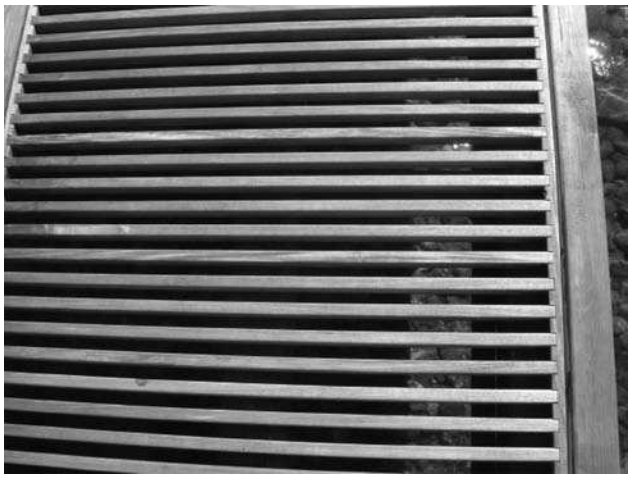

Figure 4.-50% open-spaced grating (ironwood).

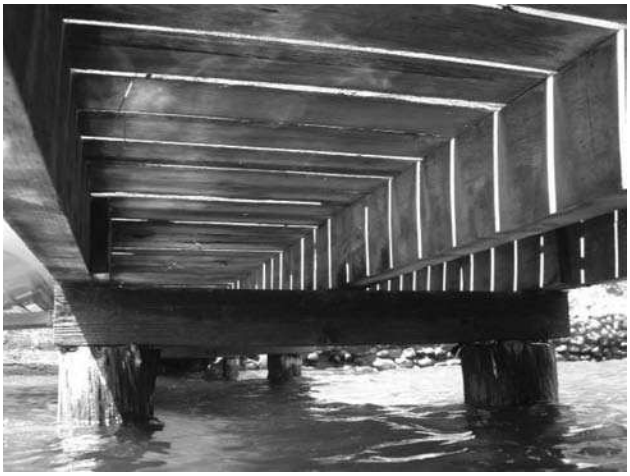

Figure 6.-Traditional decking.

Figure 5.-58% open-spaced grating (Chemgrate®).

Figure 7.-Solid decking.

Results

The mean percentage of full sunlight transmitted through grating (7.5%) was significantly greater than the percentage transmitted through prisms (0.7%), traditional decking (1.5%), and solid decking (0.2%; $p<0.001$). Additionally, traditional decking transmission was significantly greater than solid decking, but acrylic prism transmission (at the typical construction densities) was not (Fig. 8).

Discussion

While grating transmitted the greatest amount of sunlight to the water below, significantly more than prisms, traditional decking or solid decking, the lack of skirting on piers also appeared to have an effect on the amount of available sunlight beneath the piers. The light environment beneath raised piers was brighter than beneath those close to the water surface or with support structures (*e.g.*, beams, stringers) or boat bumpers around their perimeter. Such structures obstructed sunlight from reaching the water surface immediately below the pier. Also, temporary items such as kayaks, rafts and storage containers placed on or adjacent to any of the treatment types (*i.e.*, positioned in such as way to cast shadow on the grating) also appear to have an effect on the amount of transmitted sunlight.

Most piers with structural support components below the decking have many large-diameter wood pilings, support stringers (*i.e.*, lengthwise beams) and joists (*i.e.*, cross-support beams), while others had electrical conduit as well. These sub-decking structures restrict the amount of sunlight that can pass between any transmittance treatment and the water surface. Glue-laminated beams (Glu-lams), often used

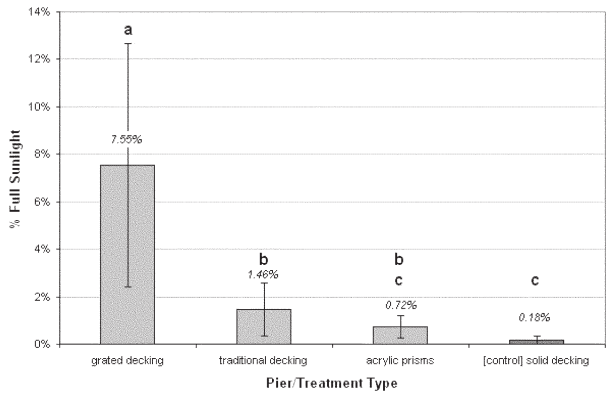

Figure 8.-Mean light transmission percentages for each category, in descending order. Different alphabetic descriptors (*e.g.*, "a", "b" and "c") indicate statistically different means (ANOVA with Tukey *a posteriori* test). Error bars represent +/- one standard error.

as support stringers, are placed along the outside edges of piers and typically extend to within 19 cm of the water, thus restricting illumination under the pier from the side. Increasing the height of the pier from the water, especially along its perimeter, orienting the lengthwise portion of the pier in a north-south direction, and minimizing pier width increases the amount of light able to reach the submarine environment directly beneath the pier (Burdick and Short 1999).

Lastly, while we evaluated three types of grating, we noted that thicker grating material with east-west load bars or mesh restricted the passage of direct sunlight to the water's surface at low sun angles.

Recommendations

The effective goal to maximize the amount of natural light beneath over-water structures is to minimize the effects of human development on Chinook salmon and the natural biota (*i.e.*, to strive for invisibility to biota in the design of man-made structures). Some recommendations to maximize light penetration include:

- maximize the amount of open space in the decking (*e.g.*, install grating with maximum open spacing) and ensure that the open space is kept uncovered or unshadowed by other pier features or gear;
- increase the distance between the bottom of support stringers and water surface (*i.e.*, raise the effective distance of the pier from the water);
- design walkway widths and/or the body of the pier to be as narrow as possible;
- minimize the number of pilings and use the smallest diameter piling as possible; and
- if native aquatic vegetation is of concern (in addition to salmonid migration and health), then pier orientation in a north/south direction will maximize the mean available sunlight to any single point beneath the pier.

Acknowledgments

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Report For:	**Thruflow Inc.** P.O. Box 40 760 Lowe Avenue Wallaceburg, ON Canada N8A 4Z9 Phone: 519 627 7960 Fax: 519 627 7969	**Laboratory #:** **Report Date:** **Received Date:** **Customer P.O.#:**	354661-04 March 10, 2004 March 10, 2004 2
Attention:	Derek McGivern		

TEST REPORT

LIGHT AVAILABILITY
OTRON THRUFLOW DOCK PANEL

1. INTRODUCTION

Otron requested the assistance of Cambridge Materials Testing Limited (CMTL) to estimate the amount of sunlight which would be available under a 4' x 4' section of dock surfaced with their ThruFlow Flooring System. The amount of available light under the dock is an important factor with regard to the sustainability of plant and animal life under dock structures.

Otron supplied an assembled 4' x 4' dock section for this testing. The section consisted of four ThruFlow panels (12" x 48") fastened to a metal frame.

Two dock surface heights were tested:

- eighteen (18) inches (tested under CMTL Lab. No. 304167-02)
- sixty (60) inches (tested under CMTL Lab. No. 307535-02).

A graph extrapolating the expected light availability over the dock height range of 0 to 60 inches is provided in this report.

This report is subject to the following terms and conditions: 1. This report relates only to the specimen provided and there is no representation or warranty that it applies to similar substances or materials or the bulk of which the specimen is a part. 2. The content of this report is for the information of the customer identified above only and it shall not be reprinted, published or disclosed to any other party except in full. Prior written consent from Cambridge Materials Testing Limited is required. 3. The name Cambridge Materials Testing Limited shall not be used in connection with the specimen reported on or any substance or materials similar to that specimen without the prior written consent of Cambridge Materials Testing Limited. 4. Neither Cambridge Materials Testing Limited nor any of its employees shall be responsible or held liable for any claims, loss or damages arising in consequence of reliance on this report or any default, error or omission in its preparation or the tests conducted. 5. Specimens are retained 3 months, test reports and test data are retained 10 years from date of final test report and then disposed of, unless instructed otherwise in writing.

Cambridge Materials Testing Limited

Per _____ *QUALITY ASSURANCE*

Per _____ *TECHNICIAN*

2. *BACKGROUND to TEST PROCEDURE*

Two routes for sunlight to irradiate the area under a 4' x 4' dock section were considered by CMTL.

Surface Light - light which passed through the slots on surface of dock

- the slots accounted for a reported 43% of the dock surface
- surface light passed through the slots in the surface of the dock and created a Partially Illuminated Area (PIA) under the dock
- the PIA consisted of illuminated and dark shadow areas corresponding to the Otron ThruFlow panel
- the frame supporting the dock panels created solid bands of frame shadow which occupied part of the area under the dock
- the PIA covered 100% of the area under the dock when the sun was directly overhead (90 degrees) minus the Frame Shadow Area (FSA)
- as the sun moved from 90 degrees to higher or lower incident light angles the PIA cast by the dock surface covered progressively less area under the dock
- the FSA changed with the incident light angle
- eventually at very low and very high incident light angles the PIA and FSA under the dock became zero.

Edge Light - light which strikes the edge plane of the dock

- incident light at sun angles below 90^{O} illuminated the area under the edge of the dock
- the percentage of area illuminated from the side plane increased from zero for incident light close to 90^{O} to 100% for low and high incident angles

3. TEST PROCEDURE

The 4' x 4' dock section was mounted so that the top surface of the dock was 18 inches and so inches above ground level. A 150 watt (120 volt) incandescent light source was sequentially positioned at the following incident light angles: 90, 75, 60, 45, 30, 20 and 10 degrees relative to the mid point of the dock section at ground level. The light source at 90 degrees simulated sunlight at noon. The light source at 0 degrees simulated sunrise or sunset.

3.0 TEST PROCEDURE (CON'D)

At each incident light angle the width of the area under the dock illuminated by Edge Light was measured. This length was used to calculate the ***Edge Light Area***. The light intensity in the Edge Light Area was the same with and without the dock in place and was assigned as 100%.

Light Availability due to Edge Light was calculated as Edge Light Area multiplied by the light intensity.

Light passing through the openings in the ThruFlow panel created a Partially Illuminated Area (PIA) under the dock. The PIA was calculated as the total dock area minus the Edge Light Area. The Frame Shadow Area (FSA) was subtracted from the PIA to determine the **Corrected PIA** under the dock.

At each incident light angle a Sekonic Illuminometer (Model 246) light meter was used to measure the light intensity at ground level at the mid point of the dock section with and without the dock in place. The reading with the dock in place was measured as the average between the illuminated and shadow areas.

The reading with the dock in place was divided by the reading without dock to calculate the Light Intensity Ratio. The distance of the light source from the mid point of the dock was kept constant for the measurements at each incident angle.

Light Availability due to Surface Light was calculated as the Corrected PIA multiplied by the average light intensity.

Total Average Light Availability (%) From 0 to 90 Degrees was calculated by adding the Light Availability Due to Edge Light and Light Availability Due to Surface Light and averaging across the 0 to 90 degree incident light range. Actual sunlight would act over a 0 to 180 degree arc but the percent light availability would be identical to the 0 to 90 degree arc.

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4. RESULTS

The measurements and calculations for estimating the light availability under the Otron ThruFlow dock panels are summarized in Tables 1 and 2. The averaged light availability measured was:

18" Dock Height	61%
60" Dock Height	84%

A graph extrapolating the expected light availability over the dock height range of 0 to 60 inches is provided below.

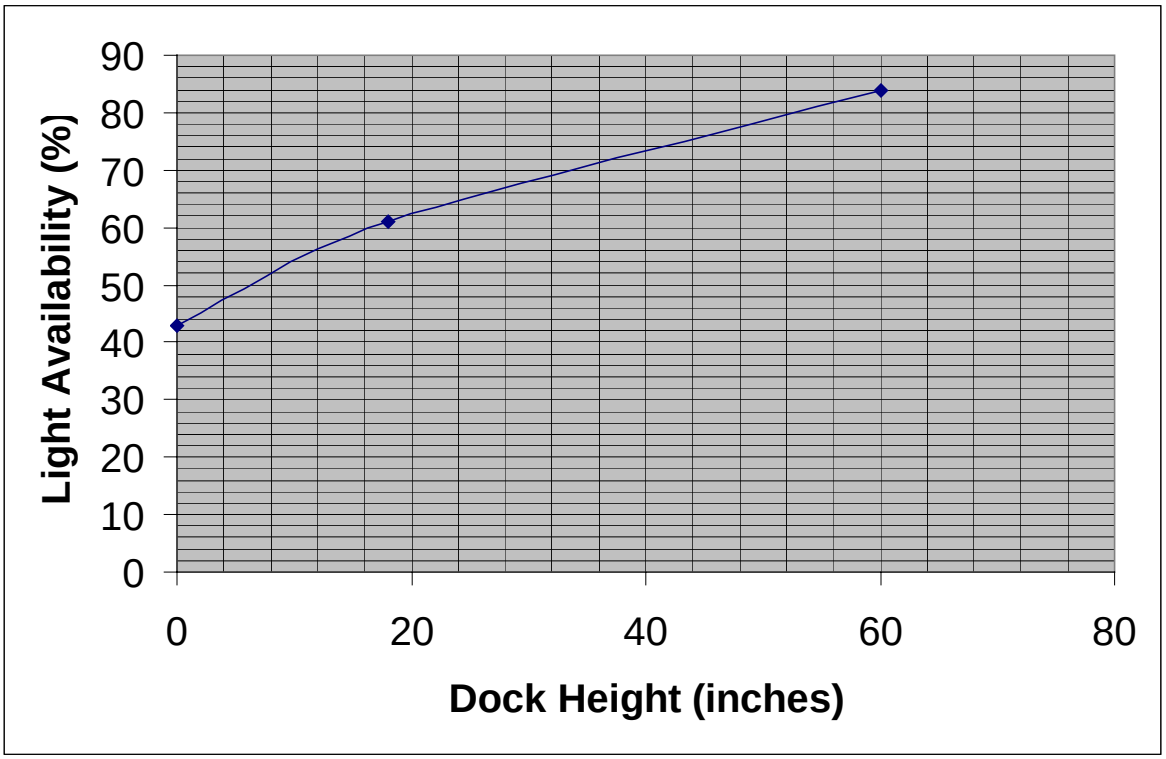

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Table 1
Light Availability – Otron Thruflow Panel
18 inch dock height

Incident Light Angle	**0**	**10**	**20**	**30**	**45**	**60**	**75**	**90**
Surface Light								
Partially Illuminated Area (%)	0	0	0	42	73	89	97	100
Frame Shadow Area (%)				8	21	22	12	6
Corrected Partially Illuminated Area				34	52	66	85	94
Light Intensity								
Light Intensity (Lx)- without dock				160	380	410	440	220
Light Intensity (Lx) - with dock				40	140	160	180	100
Light Intensity Ratio				25	37	39	41	45
Light Availability due to Surface Light (%)	**0**	**0**	**0**	***8***	***19***	***26***	***35***	***43***
Edge Light								
Edge Illumination (inches)	48.0	48.0	48.0	28.0	13.0	5.5	1.4	0.0
Edge Illumination (%)	100	100	100	58	27	11	3	0
Light Availability due to Edge Light (%)	**100**	**100**	**100**	**67**	**46**	**37**	**38**	**43**

Total Average Light Availability (%), 0 - 90^{O} 61%

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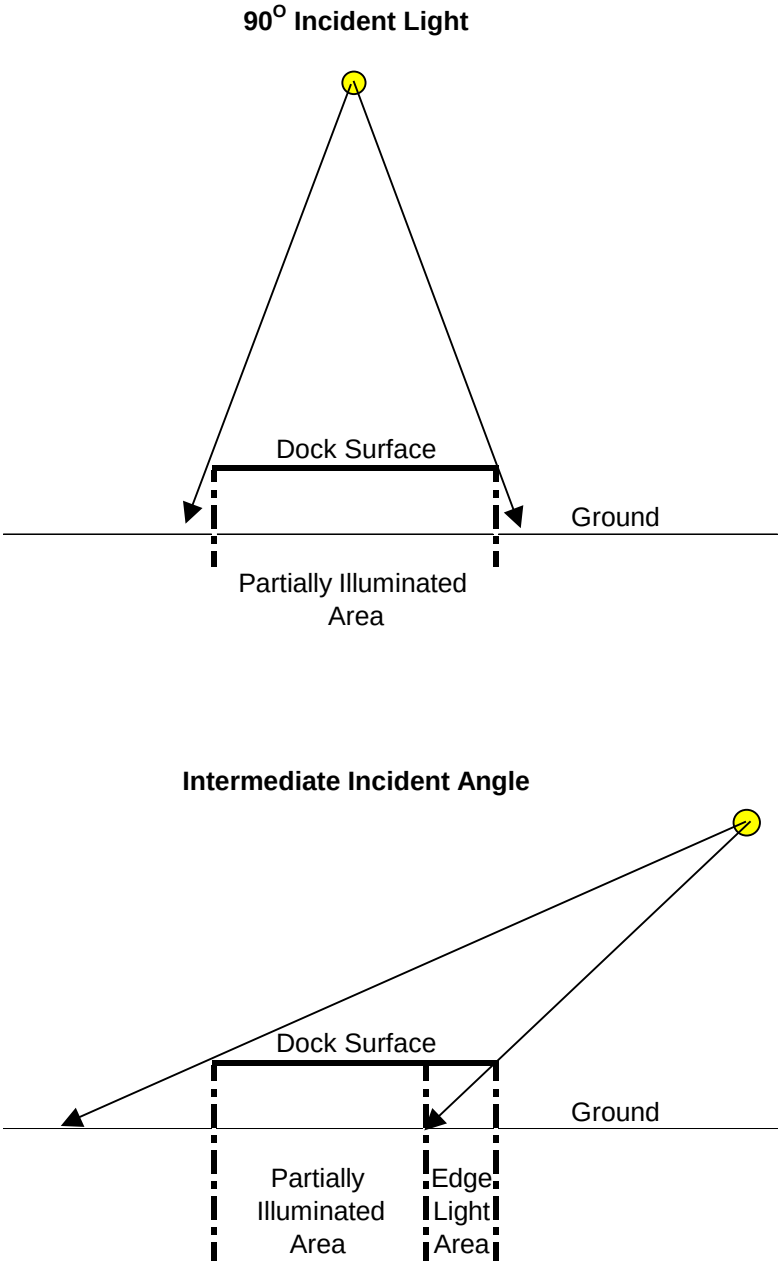
Table 1
Light Availability – Otron Thruflow Panel
5 foot dock height

	Angle of Incidence (degrees) of Light Source							
Incident Light Angle	**0**	**10**	**20**	**30**	**45**	**60**	**75**	**90**
Surface Light								
Total Grid Shadow Area (%)	0	0	0	0	0	10	74	100
Zero Light Area- frame effect				0	0	3	9	6
Partially Illuminated Area - ThruFlow panel effect				0	0	8	65	94
Partially Illuminated Area								
Light Intensity (Lx)- without dock						115	340	310
Light Intensity (Lx) - with dock						60	115	115
Light Intensity Ratio						52	34	37
Light Intensity Ratio x Partially Illuminated Area						4	22	35
Edge Light								
Edge Illumination (inches)	48.0	48.0	48.0	48.0	48.0	39.5	12.5	0.0
Edge Illumination (%)	100	100	100	100	100	82	26	0
Light Availability (%)	100	100	100	100	100	86	48	35

Average Light Availability, 0 - 90^{O}, 5 Foot Dock Height - 84 %

Figure 1 – Schematic of Test Procedure for Light Availability



Product Warranty

Limited Residential/ Commercial Warranty

ThruFlow, Inc. (hereinafter sometimes referred to as "Seller") provides to the original residential or commercial wholesale or retail purchaser of ThruFlow™ Decking Materials (hereinafter sometimes referred to as "Buyer") with the following limited warranty:

Seller warrants that the product sold is in accordance with Seller's current published specifications and/or those specifications agreed to by Seller in writing at the time of the sale, and shall be free of defects in workmanship or material under normal usage. Seller's obligation and liability under this warranty is expressly limited to repairing or replacing or tendering a credit against the purchase of, at Sellers option, ThruFlow™ Decking Materials which do not meet the specifications or are not free from defects in workmanship or material during the following time periods:

ThruFlow™ HDPE Panel	**ThruFlow™ GFPP Panel**	**ThruFlow™ Commercial Panel**
(a) Residential Applications; Seven (7) years.	(a) Residential Applications; Twelve (12) years.	(a) Residential Applications; Thirty (30) years. (b) Commercial Applications; Fifteen (15) years.

“Commercial,” as used herein, shall refer to an application intended for unrestricted public access (no entry fee), restricted public access (fee based admission or membership) or any other non-residential commercial enterprise.

Under no circumstances shall Seller be liable for any special, incidental or consequential damages, including but not limited to, personal injury, property damage, damage to or loss of product, lost profits or revenue. The purchase price for ThruFlow™ Decking Materials constitutes a consideration in limiting Seller's liability and Buyer's remedy.

SELLER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND MAKES NO WARRANTY OF MERCHANTABILITY OR FOR FITNESS FOR ANY PARTICULAR PURPOSE AND THIS LIMITED WARRANTY IS IN LIEU THEREOF.

The quality of ThruFlow™ Decking Materials shall be in accordance with Seller's specifications. A final determination of the suitability of product for the use as contemplated by Buyer is the sole responsibility of Buyer, and Seller shall have no responsibility in connection with such determination of suitability.

This limited warranty shall not apply to any product subject to misuse due to common negligence or accident, nor to any product made by Seller not used in accordance with the printed instructions or specifications of Seller, or that have been used beyond the represented and rated capacity of ThruFlow™ Decking Materials. Seller does not warrant against and is not responsible for any condition attributable to the improper installation of ThruFlow™ Decking Materials and/or failure of Buyer to abide by installation guidelines for ThruFlow™ Decking Materials, including but not limited to, the use of ThruFlow™ Decking Materials beyond normal commercial use or in an application not recommended by ThruFlow™ Decking Materials guidelines and/or local codes, movement, collapse or settling of the ground or supporting structure on which ThruFlow™ Decking Materials are installed, improper handling, storage, abuse or neglect of ThruFlow™ Decking Materials by Buyer or third parties.

This limited warranty is applicable only to those parties heretofore mentioned, and is not assignable, transferable, nor will it inure to the benefit of anyone other than the original residential or commercial, retail or wholesale purchaser.

This warranty gives Buyer specific legal rights, and Buyer may also have other rights that very from State to State. The limitations or exclusions set forth in this limited warranty may not apply to all Buyers, as some States do not allow the exclusion or limitation of incidental or consequential damages.

WARRANTY PROCESS

ThruFlow, Inc. will repair, replace, or tender credit against further purchases, at its sole discretion, of any ThruFlow™ Decking Materials that are defective in material or workmanship. Repair work or replacement of ThruFlow™ Decking Materials will be at no charge to the original Purchaser. In order for Buyer to avail itself of warranty obligations on the part of Seller, Buyer must

I. Send by certified mail, the original purchase invoice/receipt indicating the date and location of purchase by original Purchaser to: 1239 Dufferin Avenue, Suite B, Wallaceburg, Ontario, N8A 2W3;

II. Provide Seller the reasonable opportunity to inspect all ThruFlow™ Decking Materials claimed to be defective or damaged under the terms of the warranty.

Seller must concur that ThruFlow™ Decking Materials are defective, Seller shall deliver to the original Purchaser, at Seller's expense, all repaired or replacement ThruFlow™ Decking Materials. Seller shall not be liable for any installation or reinstallation costs.