

A photograph of a modern composite fiber bridge spanning a river. The bridge features a series of white, V-shaped supports and a dark deck. Below the bridge, the river flows over a rocky waterfall, creating white rapids. The surrounding landscape is a dense forest of evergreen and deciduous trees. The text "Composite Fiber Bridge Technology" is overlaid in large white letters, and "FACERS Fall Meeting 2022" is overlaid in smaller white letters below it.

# Composite Fiber Bridge Technology

FACERS Fall Meeting 2022

Presented By: Dennis Higgins and Irwin Burton



# COMPOSITE FIBER TECHNOLOGIES (CFT)

**WAGNERS**

**MANUFACTURING  
STRUCTURAL  
COMPOSITES  
SINCE 2003**



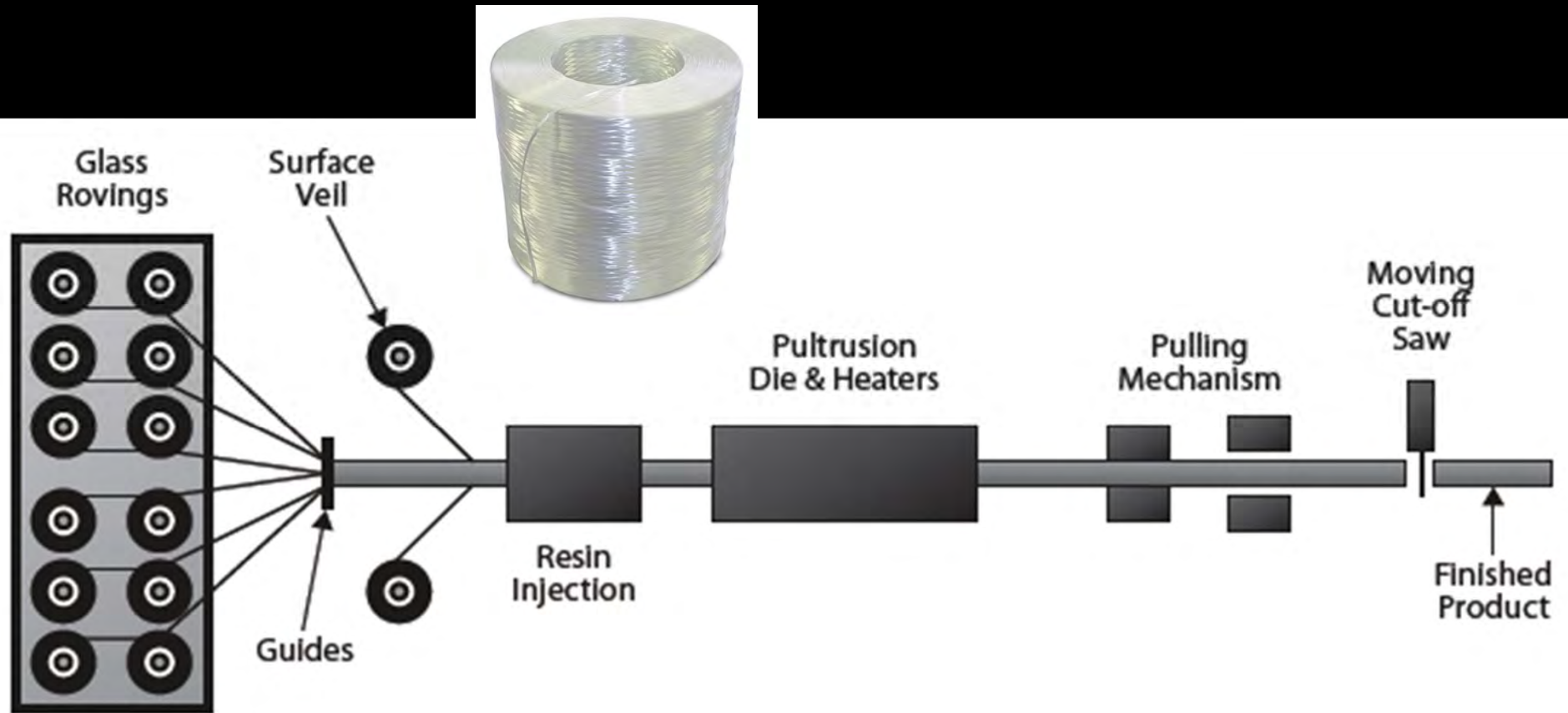
Head Office in Toowoomba,  
Queensland, Australia.  
Fabrication facility in  
Weatherford, TX.



165 employees servicing global  
infrastructure projects



Five (5) pultrusion lines  
manufacturing 2.1 million feet of  
structural fiberglass annually



## PULTRUSION PROCESS







# SQUARE HOLLOW SECTIONS - WCFT Grade GV35-S

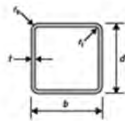
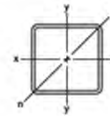


Table 2.1  
DIMENSIONS & SECTION PROPERTIES  
SQUARE HOLLOW SECTIONS  
WCFT Grade GV35-S  
Fibre Reinforced Polymer (FRP)



DIMENSIONS							SECTION PROPERTIES							
Designation			Outside Corner Radius	Inside Corner Radius	Mass	External Surface Area	Gross Section Area	About x- and y-axes			About z-axes		Torsion Constant	Torsion Modulus
Depth d	Width b	Thick. t	r <sub>o</sub>	r <sub>i</sub>	per m	per m	A <sub>g</sub>	I <sub>x</sub>	Z <sub>x</sub>	r <sub>x</sub>	I <sub>y</sub>	Z <sub>y</sub>	J	C
mm	mm	mm	mm	mm	kg/m	m <sup>2</sup> /m	mm <sup>2</sup>	10 <sup>6</sup> mm <sup>4</sup>	10 <sup>3</sup> mm <sup>3</sup>	mm	10 <sup>6</sup> mm <sup>4</sup>	10 <sup>3</sup> mm <sup>3</sup>	10 <sup>6</sup> mm <sup>4</sup>	10 <sup>6</sup> mm <sup>3</sup>
WFT 125 x 125 x 6.4 SHS	10.0	4.75	5.85	0.483	2970	6.89	110	48.2	6.80	81.9	10.9	48.2	455	48.2
WFT 100 x 100 x 5.2 SHS	10.0	4.75	3.75	0.383	1905	2.80	56.1	38.4	2.81	42.5	4.55	38.4		

# RECTANGULAR HOLLOW SECTIONS - WCFT Grade GV35-S

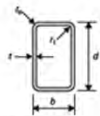


Table 2.2  
DIMENSIONS & SECTION PROPERTIES  
RECTANGULAR HOLLOW SECTIONS  
WCFT Grade GV35-S  
Fibre Reinforced Polymer (FRP)



DIMENSIONS						SECTION PROPERTIES											
Designation			Outside Corner Radius $r_o$	Inside Corner Radius $r_i$	Mass  per m	External Surface Area per m	Gross Section Area $A_g$	About x-axis			About y-axis			Torsion Constant  J	Torsion Modulus  C		
Depth d	Width b	Thick. t						$I_x$	$Z_x$	$r_x$	$I_y$	$Z_y$	$r_y$				
mm	mm	mm	mm	mm	kg/m	m <sup>2</sup> /m	mm <sup>2</sup>	10 <sup>6</sup> mm <sup>4</sup>	10 <sup>3</sup> mm <sup>3</sup>	mm	10 <sup>6</sup> mm <sup>4</sup>	10 <sup>3</sup> mm <sup>3</sup>	mm	10 <sup>6</sup> mm <sup>4</sup>	10 <sup>6</sup> mm <sup>3</sup>		
WCFT 100 x 75 x 5.0 RHS	100	75	5.0	RHS	10.0	4.75	3.12	0.333	1584	2.14	42.8	36.8	1.37	36.5	29.4	2.76	59.2

# BONDED RECTANGULAR BEAMS - WCFT Grade GV35-S

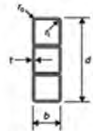
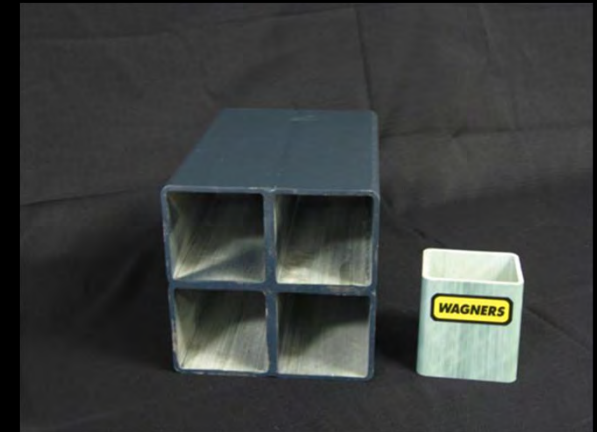


Table 4.1  
DIMENSIONS & SECTION PROPERTIES  
BONDED RECTANGULAR BEAMS  
WCFT Grade GV35-S  
Fibre Reinforced Polymer (FRP)

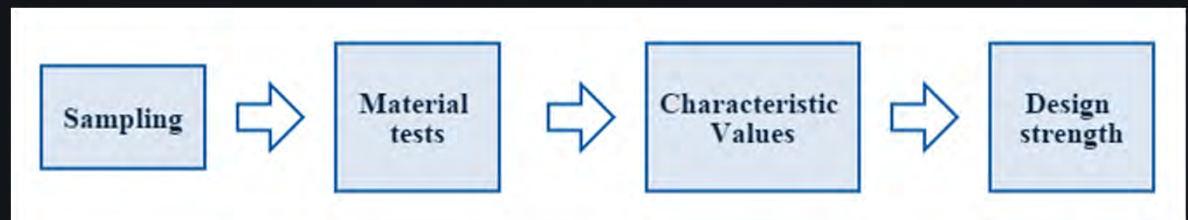


DIMENSIONS						SECTION PROPERTIES									
Designation	Outside Corner Radius	Inside Corner Radius	Mass	External Surface Area	Gross Section Area	About x-axis			About y-axis			Torsion Constant J			
Depth d mm	Width b mm	Thick. t mm	r <sub>o</sub> mm	r <sub>i</sub> mm	per m kg/m	per m m <sup>2</sup> /m	A <sub>g</sub> mm <sup>2</sup>	I <sub>x</sub> 10 <sup>6</sup> mm <sup>4</sup>	Z <sub>x</sub> 10 <sup>3</sup> mm <sup>3</sup>	r <sub>x</sub> mm	I <sub>y</sub> 10 <sup>6</sup> mm <sup>4</sup>	Z <sub>y</sub> 10 <sup>3</sup> mm <sup>3</sup>	mm	10 <sup>6</sup> mm <sup>4</sup>	
WCFT 625 x 125 x 6.40 BRB	10.0	4.75	29.3	1.37	14848	498	1595	183	34.4	531	48.2	54.6			
WCFT 500 x 125 x 6.40 BRB	10.0	4.75	23.4	1.30	11679	260	1038	148	27.5	441	48.2	43.7			
WCFT 375 x 125 x 6.40 BRB	10.0	4.75	17.6	1.03	8909	113	605	113	20.7	350	48.2	32.8			
WCFT 250 x 125 x 6.40 BRB	10.0	4.75	11.7	0.756	5939	37.0	296	78.9	13.8	220	48.2	21.8			
WCFT 500 x 100 x 5.20 BRB	10.0	4.75	18.8	1.27	9527	205	818	147	14.6	280	58.4	22.8			
WCFT 400 x 100 x 5.20 BRB	10.0	4.75	15.0	1.05	7621	166.5	532	118	11.2	224	58.4	18.2			
WCFT 300 x 100 x 5.20 BRB	10.0	4.75	11.3	0.828	5716	46.5	310	96.2	8.41	168	58.4	15.7			
WCFT 200 x 100 x 5.20 BRB	10.0	4.75	7.51	0.606	3811	15.1	151	63.0	5.61	112	58.4	9.11			



## Derivation of Characteristic Material Properties

ASCE (2010) *Pre-Standard for Load and Resistance Factor Design (LRFD) of Pultruded Fiber Reinforced Polymer (FRP) Structures (Final)*, American Society of Civil Engineers



### Fiber Reinforced Polymer Properties

- High Strength
- Low Weight – 20% of steel, 40% of timber
- Chemically Inert – won't rot, rust, or corrode. Nothing eats it.
- Won't sustain combustion – inherently fire resistant.

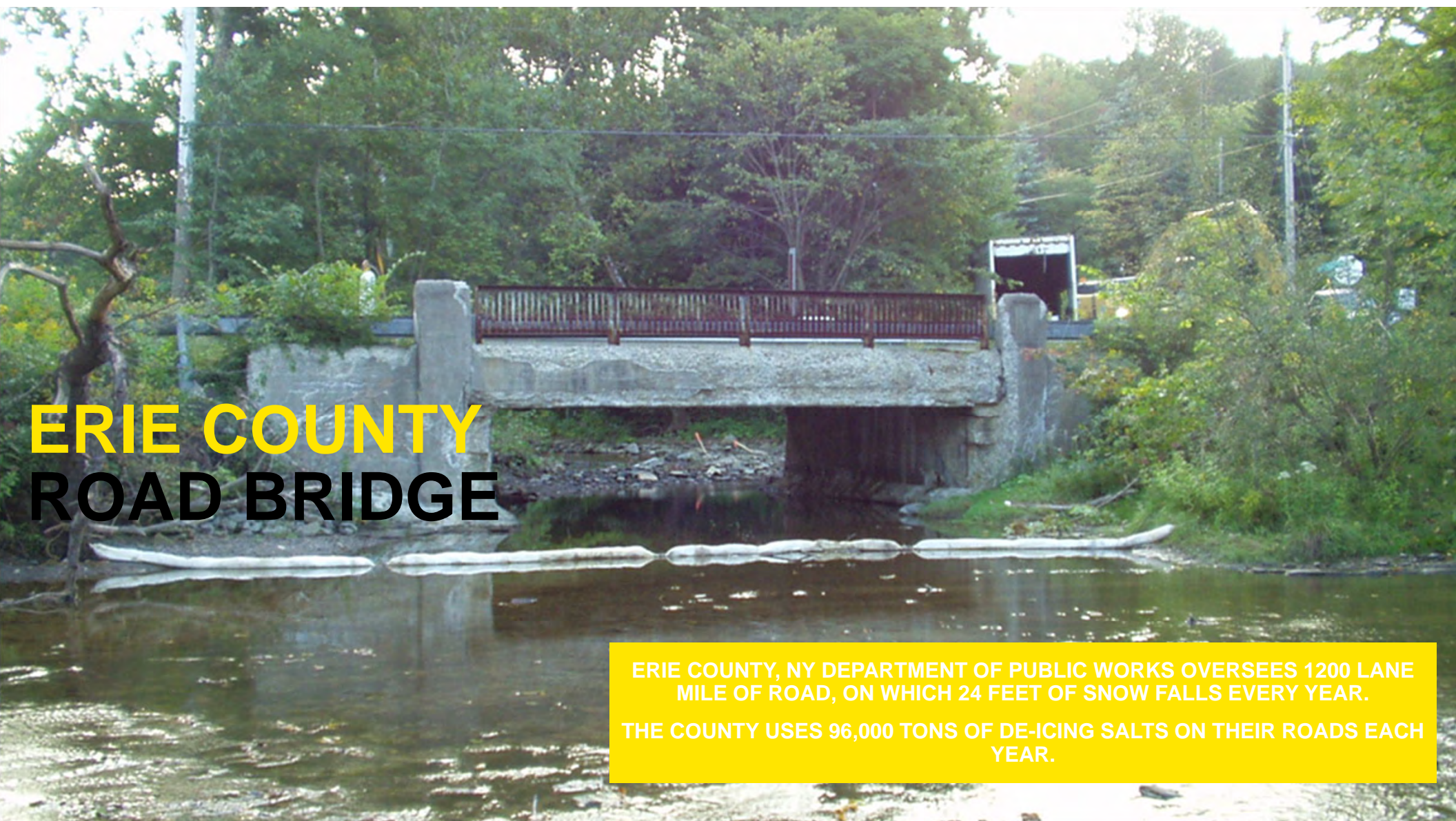
# ROAD BRIDGES

## COMPOSITE BEAMS & GIRDERS

2003







# ERIE COUNTY ROAD BRIDGE

ERIE COUNTY, NY DEPARTMENT OF PUBLIC WORKS OVERSEES 1200 LANE  
MILE OF ROAD, ON WHICH 24 FEET OF SNOW FALLS EVERY YEAR.  
THE COUNTY USES 96,000 TONS OF DE-ICING SALTS ON THEIR ROADS EACH  
YEAR.





- A series of 5 road bridge replacement projects conducted beginning in 2004 through FHWA's "Innovative Bridge Replacement and Construction Program" or IBRC
- Five hybrid FRP/concrete bridge superstructure/deck, with an average time of 31 days for demolition of existing bridges and installation of new bridges



- Previously, significant maintenance was conducted every 3 years
- The hybrid FRP/concrete bridges have required zero maintenance for their 19-year installed life – as expected.



## NEW OREGON ROAD BRIDGE – ERIE COUNTY, NEW YORK



**BONDED FRP U-  
GIRDERS WITH FOAM  
FILL “SACRIFICIAL  
FORMS” FOR  
MULTISPAN BRIDGE  
REPLACEMENT**



# KYOGLE ROAD BRIDGE

# PEDESTRIAN & TRAIL BRIDGES

- Girder Bridge spans to 40 ft
- Light Riveted Truss Bridge spans to 60 ft
- Heavy Bolted Truss Bridge spans up to 120 ft
- Designs in accordance with AASHTO Guide Specification for Design of FRP Pedestrian Bridges





## PFIEFFER FALLS TRAIL BRIDGE – BIG SUR STATE PARK, CA







**PFIEFFER FALLS BRIDGE – BIG SUR STATE PARK**





## Ernie Miller Park Bridge, Johnson County, Kansas

80x10' Traffic Width





**Mersey River Bridge - Kejimikujik National Park Nova Scotia,  
100'x6' Traffic Width**

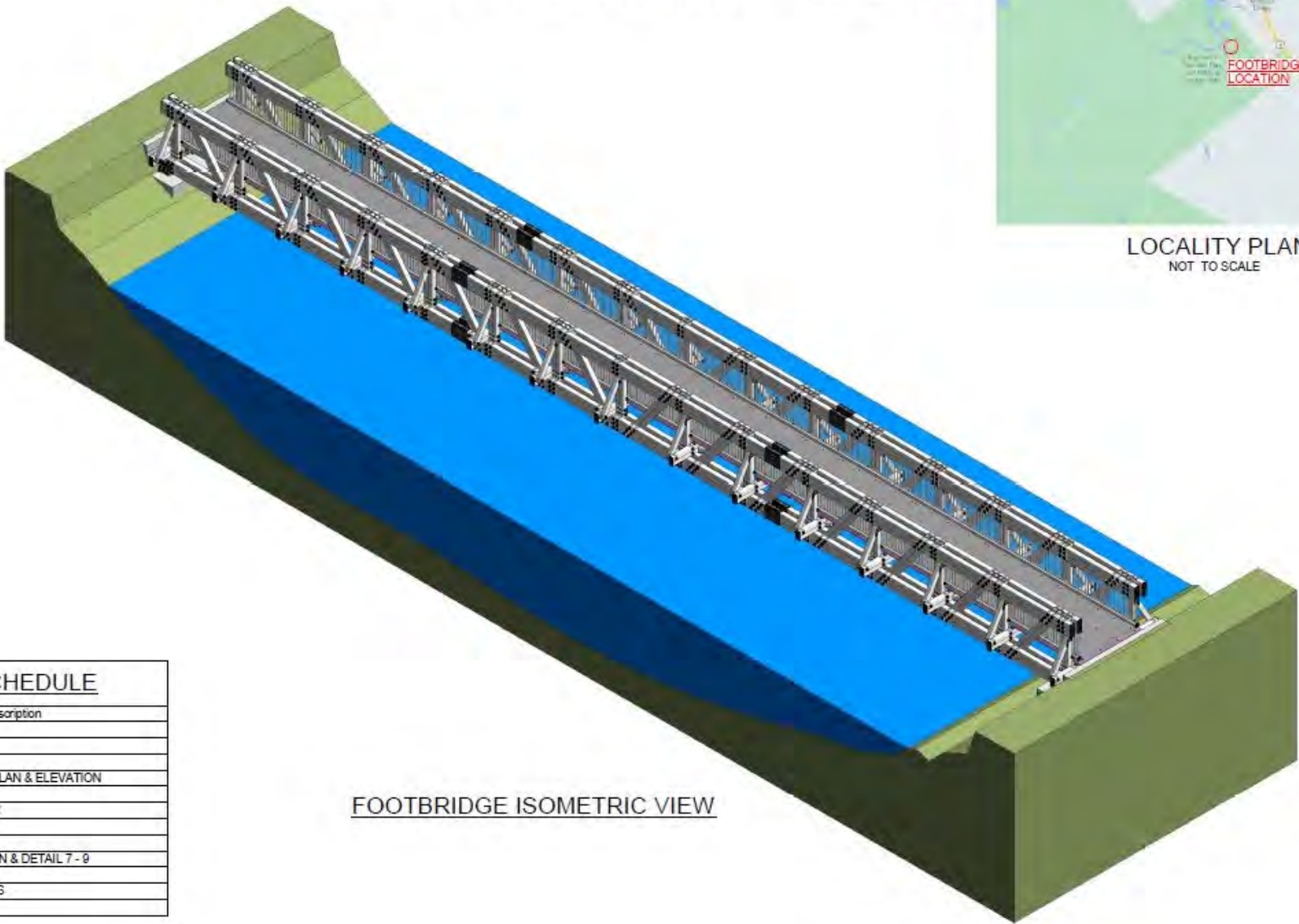




KEJIMKUJIK NATIONAL PARK, NOVA SCOTIA CANADA



LOCALITY PLAN  
NOT TO SCALE



FOOTBRIDGE ISOMETRIC VIEW

DRAWING SCHEDULE

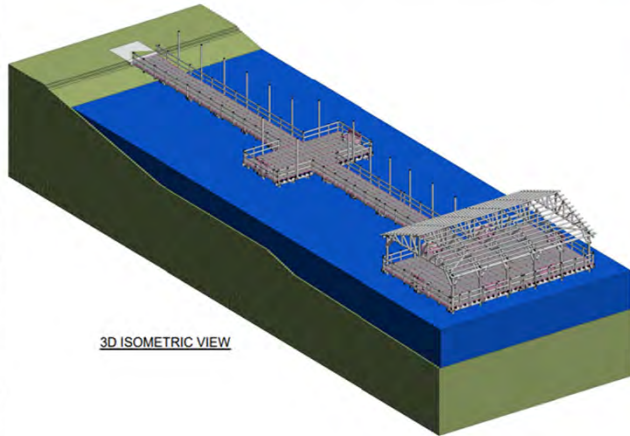
Sheet	Description
S001	LOCALITY PLAN
S002	GENERAL NOTES
S100	LAYOUT PLAN
S101	STRUCTURAL LAYOUT PLAN & ELEVATION
S102	SECTION A & B
S103	SECTION C, DETAIL 1 & 2
S104	DETAIL 3 & 4
S105	DETAIL 5 & 6
S106	ABUTMENT LAYOUT PLAN & DETAIL 7 - 9
S107	ABUTMENT SETUP
S108	TYPICAL SPLICE DETAILS
S109	TYPICAL DETAILS



# MARINE STRUCTURES



# SAN ANGELO FISHING PIER



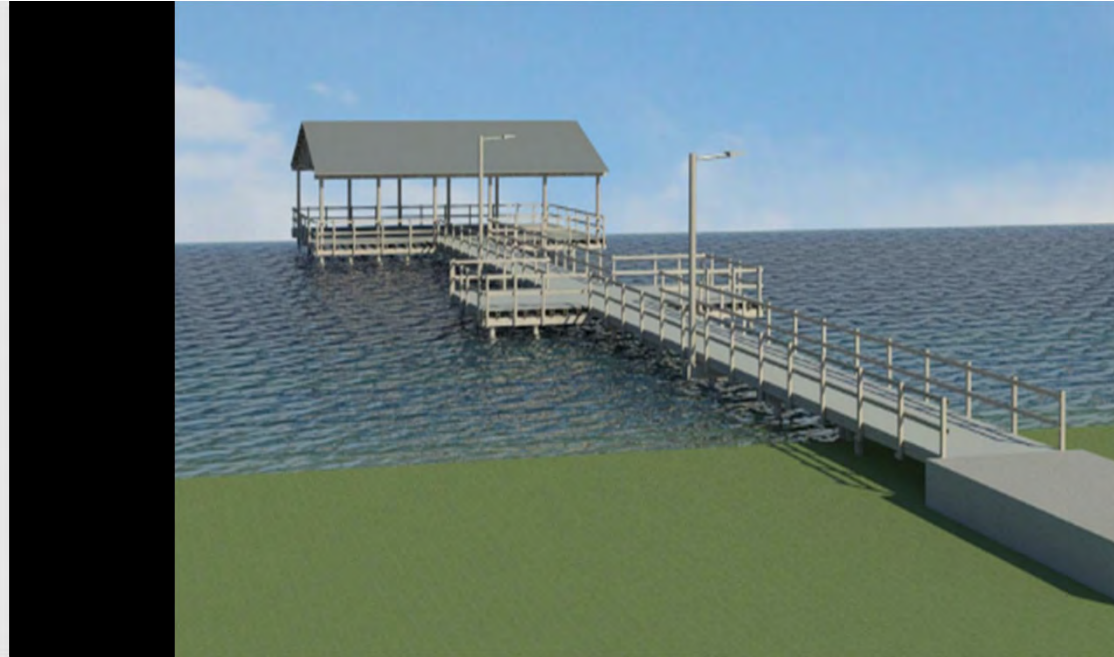
3D ISOMETRIC VIEW



LOCATION PLAN  
NOT TO SCALE

## DRAWING SCHEDULE

Sheet	Description
0001	COVER SHEET
0002	GENERAL NOTES 1
0003	GENERAL NOTES 2
0100	OVERALL PLAN VIEW & ELEVATION
0101	PLAN VIEW FOR ZONE 1 TO 3
0102	PLAN VIEW FOR ZONE 4
0103	ROOF STRUCTURAL PLAN
0104	PLATFORM ELEVATIONS
0105	PIER LAYOUT
0106	SECTION A, B & C
0107	SECTION D
0108	SECTION E
0109	SECTION F & G
0110	SECTION H
0111	DETAIL 1, 2 & 3
0112	DETAIL 4 & 5
0113	DETAIL 6 & 7
0114	DETAIL 8 & 9
0115	DETAIL 10 & 11
0116	DETAIL 12
0117	DETAIL 13 & 14
0118	DETAIL 15 - BENCH SEAT SET 1
0119	DETAIL 16 & 18 - BENCH SEAT SET 2 & 3
0120	SECTIONAL PAIR SPACE DETAILS
0121	TYPICAL DETAIL 1



Client's Acceptance:	
1. REVIEWED FOR CONSTRUCTION	07/07/20
2. REVIEWED FOR CONSTRUCTION	08/07/20
3. REVIEWED FOR CONSTRUCTION	09/07/20
4. REVIEWED FOR CONSTRUCTION	10/07/20



FOR COVER SHEET

FOR CONSTRUCTION





## Beach Access Stairs/ Dune Crossing

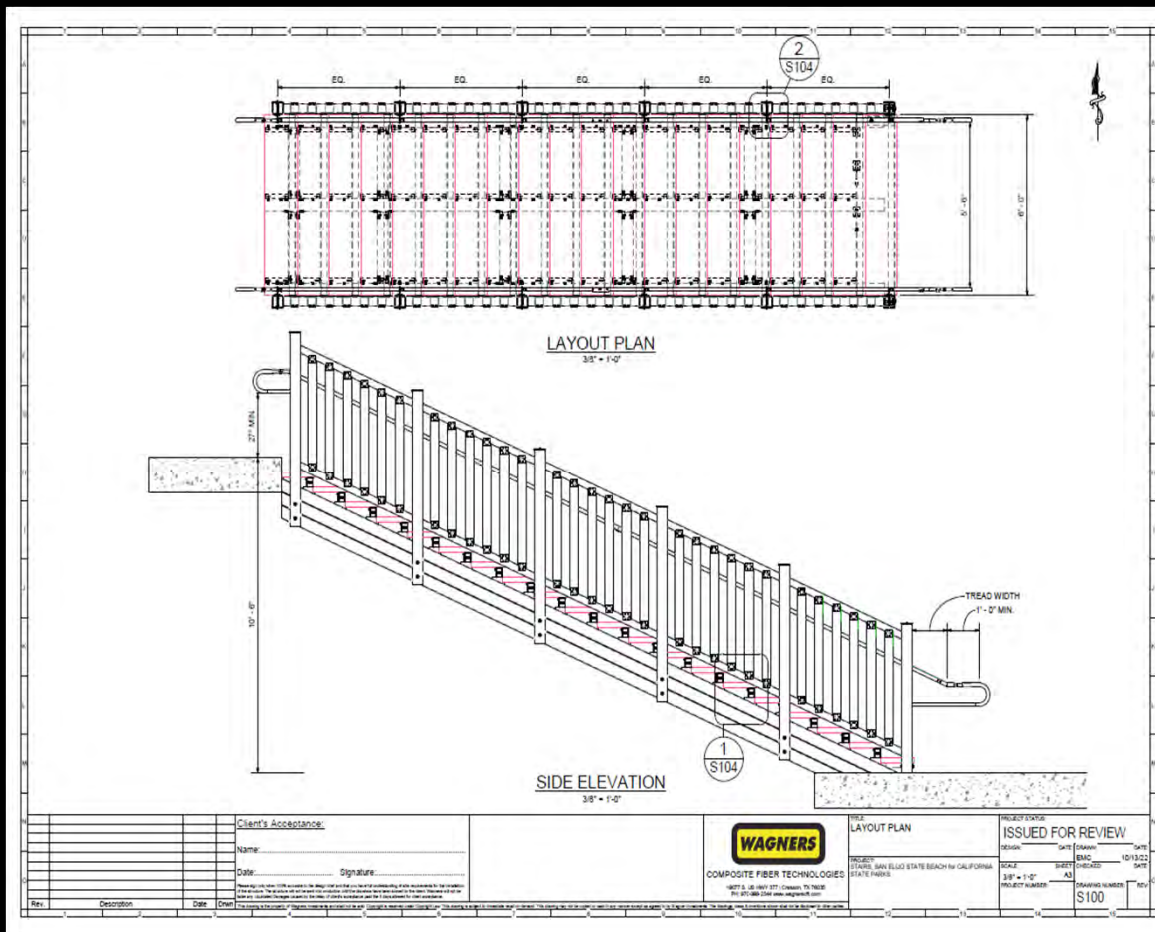




# San Elijo Beach Access Staircase

San Elijo State Park, Cardiff, California

- 8 Staircase project. Giving campers, surfers, and the public access to the beach
- Built completely in Fiber Reinforced Polymer: Stringers, treads, risers, handrail, guardrail and pickets

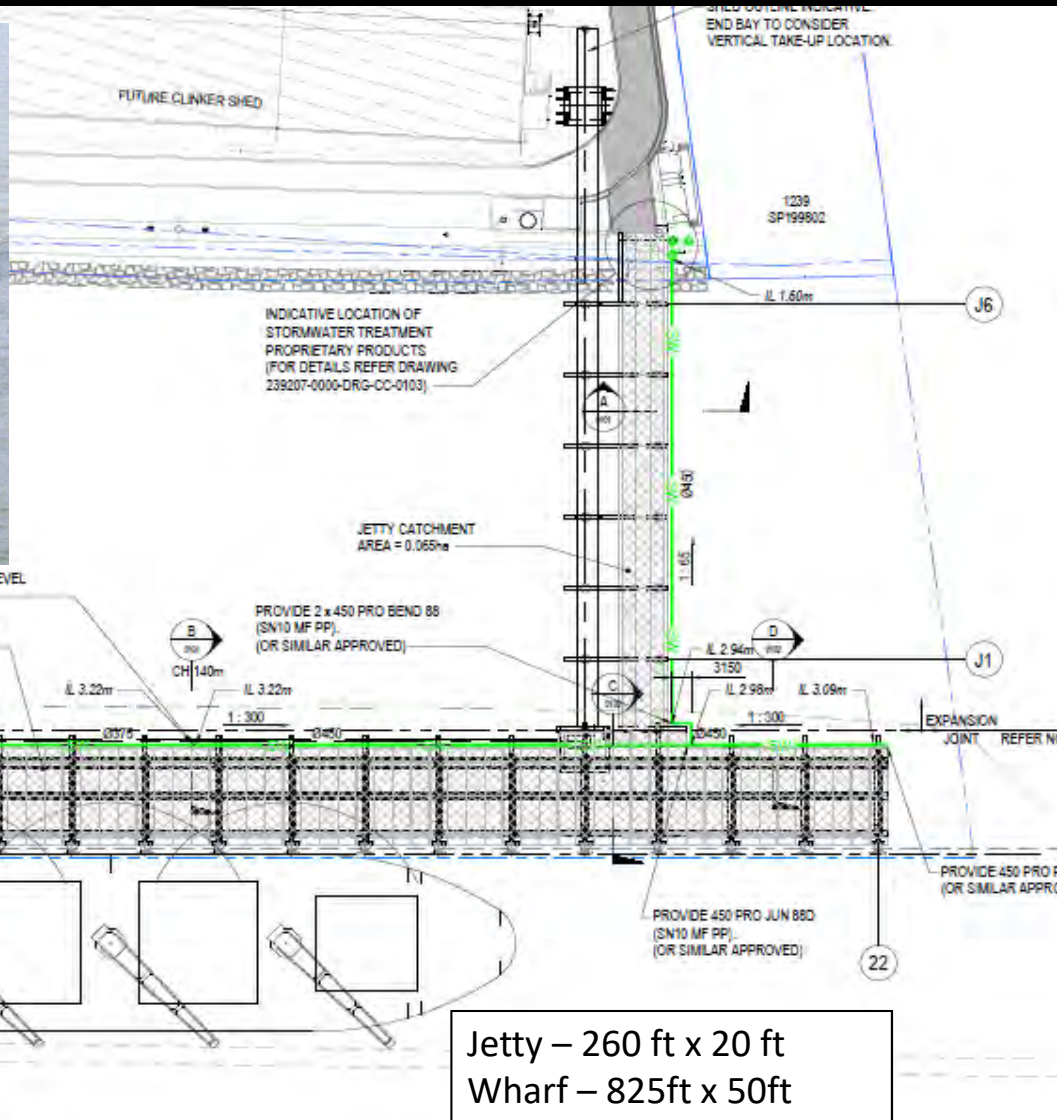




# PINKENBA WHARF PROJECT

LARGEST FRP  
STRUCTURE IN  
THE WORLD







191 PREFABRICATED  
PANELS SPANNING  
25FT – 36FT EACH

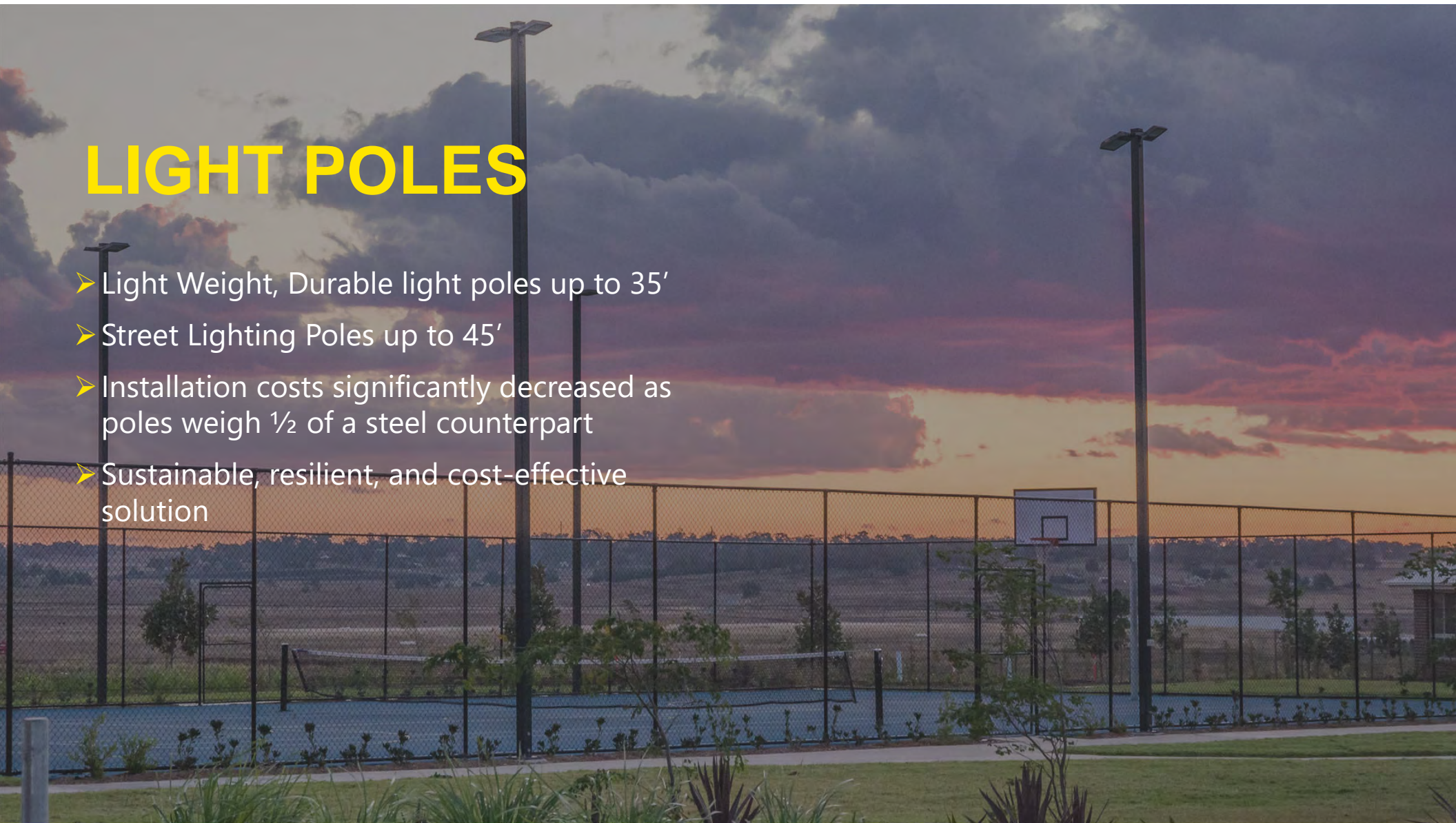
DESIGNED AND BUILT  
USING SERIES OF  
WAGNERS U-GIRDERS

# PINKENBA WHARF PROJECT



# LIGHT POLES

- Light Weight, Durable light poles up to 35'
- Street Lighting Poles up to 45'
- Installation costs significantly decreased as poles weigh ½ of a steel counterpart
- Sustainable, resilient, and cost-effective solution



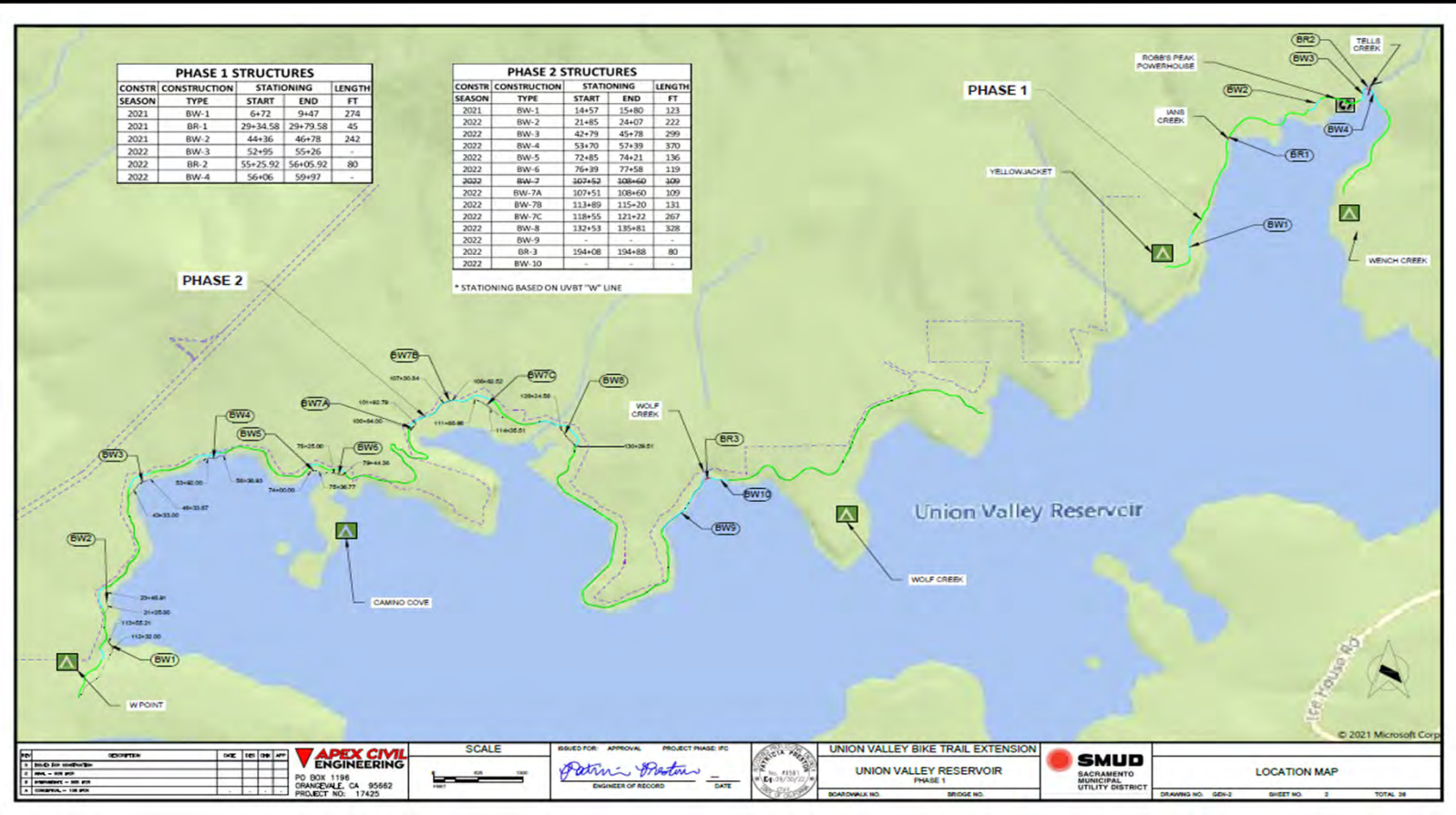
# BOARDWALKS

- Light Weight Makes For Easier Handling During Construction
- High Strength Allows For Top-Down Construction With Heavy Equipment
- 100 year Asset Design Life. Whole-Of-Life Costs 25% Of PT Timber

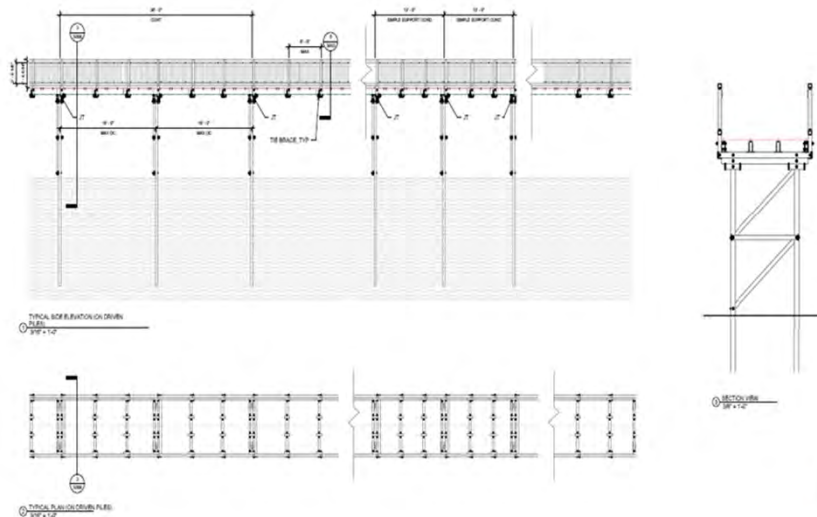




# Union Valley Reservoir, El Dorado National Forest, California



# Union Valley Boardwalk Structures



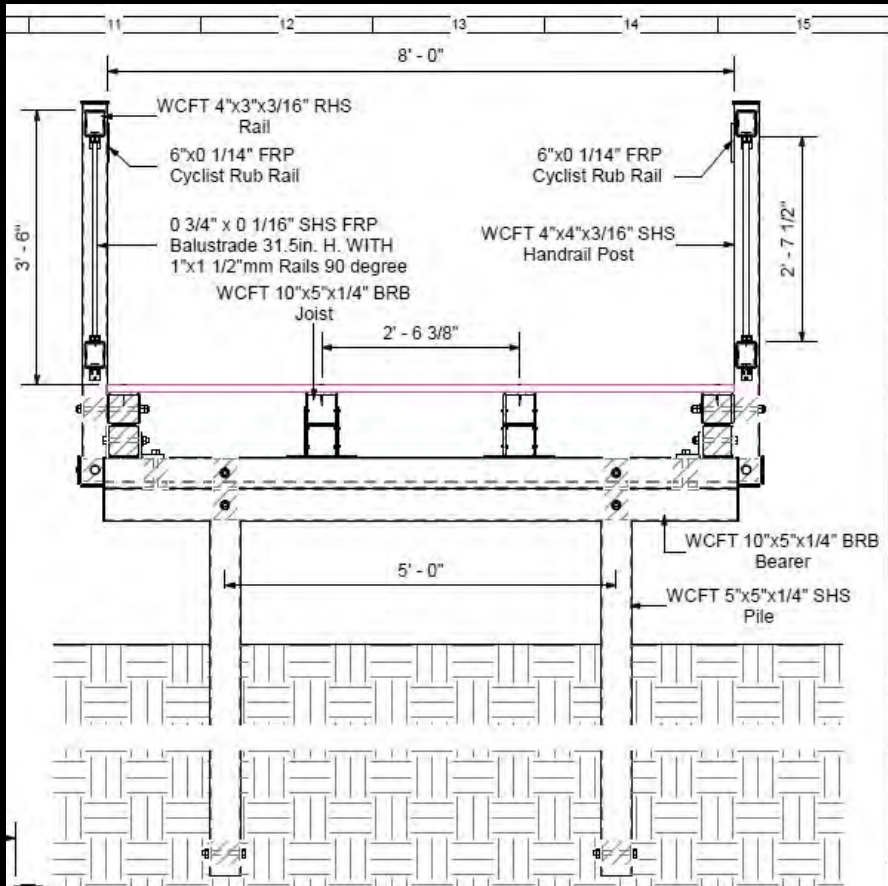
ISSUED FOR CONSTRUCTION  
PERMIT NUMBER:  
10/10/2010 10/10/2010



ISSUED FOR CONSTRUCTION  
PERMIT NUMBER:  
10/10/2010 10/10/2010













# Q&A





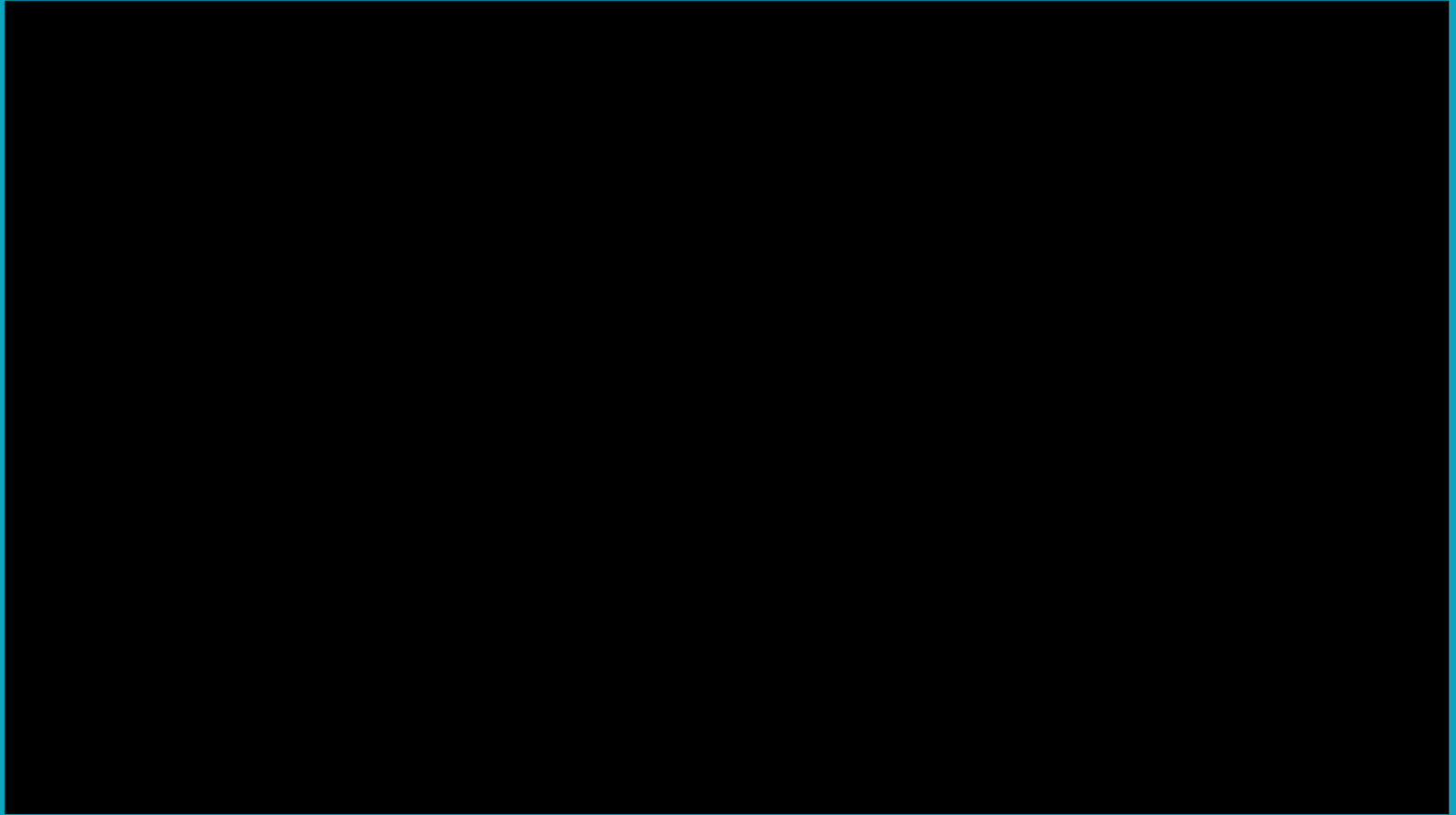
# EARTH FRIENDLY CONCRETE

by **WAGNERS**



**EFC® Concrete Supply**

# EFC® Major Projects





The background of the entire slide is a photograph of a stack of curved concrete slabs. Each slab has the word 'WAGNERS' in a black rectangular box and 'EFC' in large, bold, black letters. The slabs are stacked in a way that shows their curved shape and the texture of the concrete. The background is slightly blurred, showing some greenery and a clear sky.

**WAGNERS**

# EARTH FRIENDLY CONCRETE®

- Cement production is responsible for 8% of the world's carbon emissions
- Wagners EFC® provides increased strength, durability and contains no cement
- Utilizing the waste products of steel and coal production, Wagners have created the cleanest concrete available on the market

An aerial photograph of the Wellcamp Airport. In the center is a large, modern terminal building with a glass facade and a flat roof. To the left of the terminal is a large parking lot filled with cars. In the foreground, a wide, light-colored paved runway or taxiway stretches across the frame, marked with yellow lines. A small white twin-engine propeller plane is parked on the tarmac, and a helicopter is visible on the left. The background shows a green field and a line of trees under a clear sky.

**WAGNERS**

**9200 Feet RUNWAY,  
CAPABLE OF  
LANDING ANY  
COMMERCIAL  
AIRCRAFT**

# **WELLCAMP AIRPORT PROJECT**

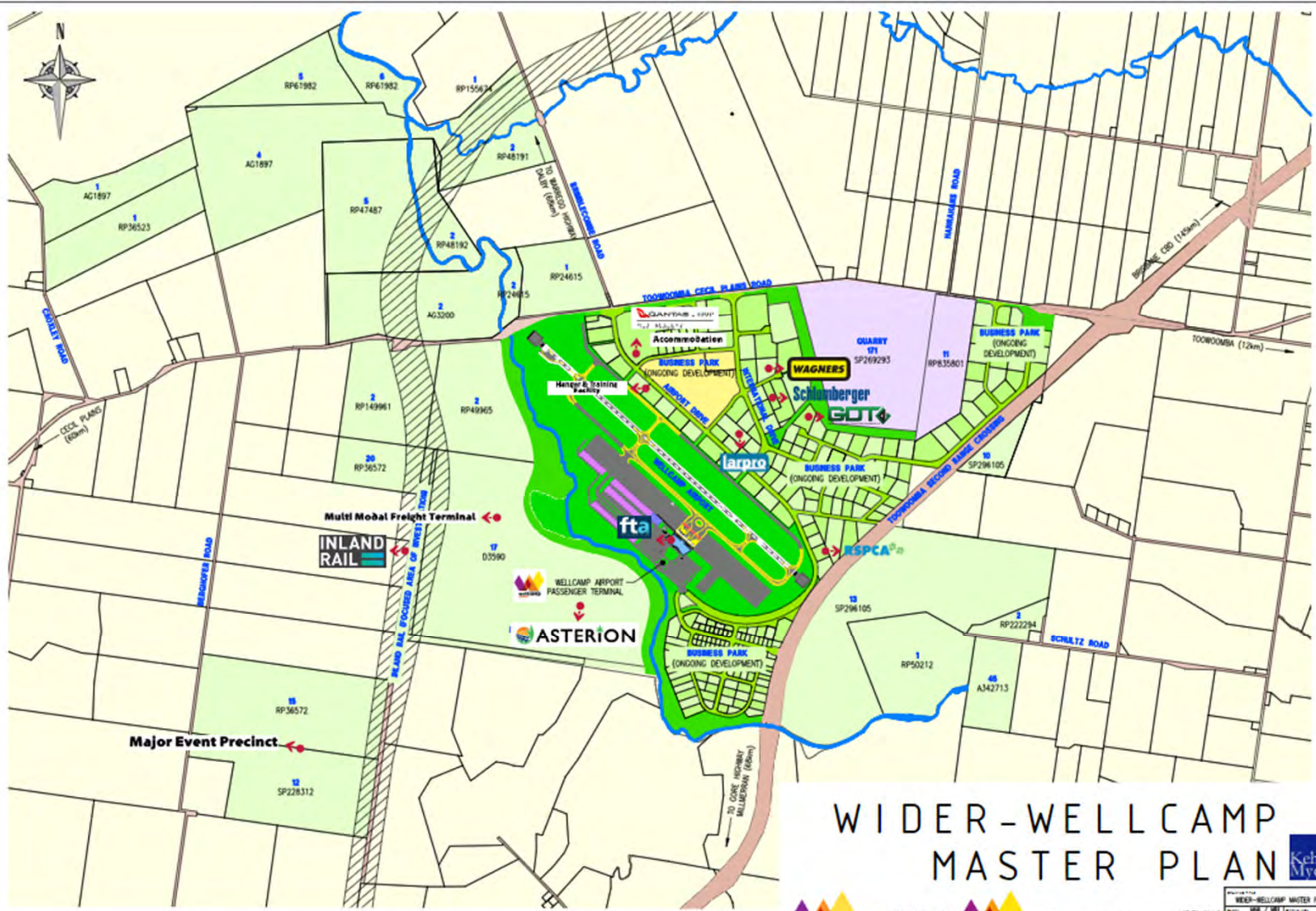
**EFC® WAS USED IN THE  
CONSTRUCTION, SAVING  
17,000 TON'S OF CARBON  
EMISSIONS FROM THE  
ATMOSPHERE**



# INTERNATIONAL CARGO HUB



**AUSTRALIA'S NEW AIR FREIGHT HUB**



# WIDER-WELLCAMP MASTER PLAN





WIDER-WELLCAMP MASTER PLAN	
PROJECT NO.	WIDER-WELLCAMP MASTER PLAN
DATE	2017/07/01
REVISION	1.0
PROJECT NO.	WIDER-WELLCAMP MASTER PLAN
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DATE	2017/07/01
REVISION	1.0

# WELLCAMP BUSINESS PARK





# PILOT TRAINING FACILITY

# WELLCAMP ENTERTAINMENT PRECINCT

