LANGAN
DESIGN
PARTNERS

JT Schooner
Preliminary Performance Review

November 3rd, 2016

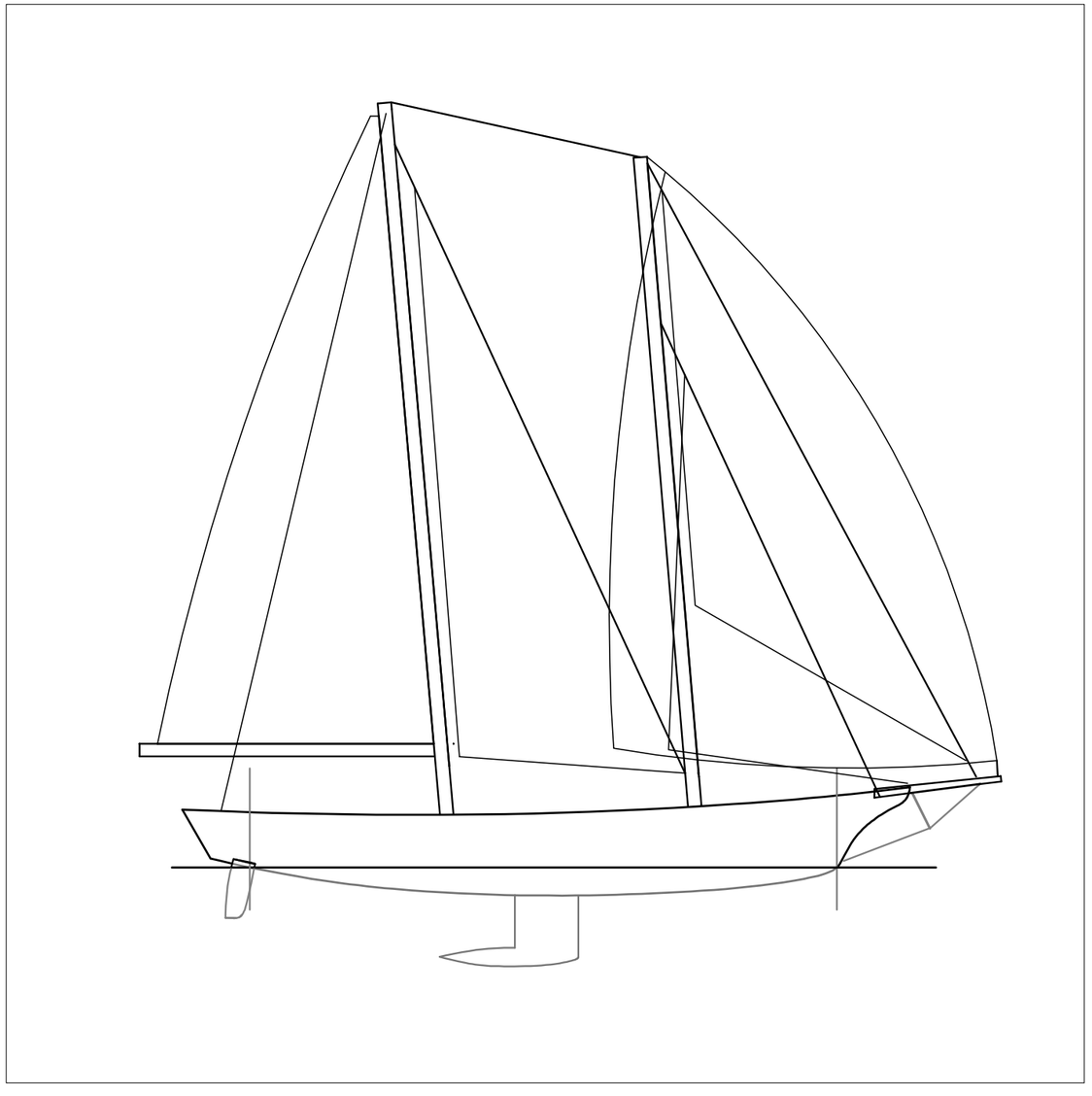
Introduction

The following document presents the results of a preliminary review of the configuration and performance of a schooner for Mr. James Turrell. The data presented in this study is preliminary and is intended to inform the decisions that need to be made in defining the general parameters of the vessel.

General Parameters

For this study the following general parameters have been used. These numbers are likely to change as the design firms up.

Length, Overall (Including bowsprit)	28.926 m	68'-1"
Length, On Deck	25.705 m	84'-4"
Length, Waterline	20.750 m	94'-11"
Beam, Max	6.105 m	20'-0.5"
Draft, Minimum	2.134 m	7'
Draft, Maximum	3.480 m	11'-5"
Sail Area, Upwind (no fisherman)	315 sq.m	3,390 sq.ft



Preliminary Weight Build-Up

The table below details the weight build-up used in the calculations that follow. This is a start-point point. The weights will get more accurate as the design firms up, the construction method selected and the detailed equipment list gets included.

Weight Group	Description	Weight (lbs)	Weight (kg)	Notes
A - Hull	Hull struction	15,840	7,185	Assumes e-glass with some carbon
B - Sprstr	Superstructure (deck + house)	6,470	2,935	Assumes e-glass with some carbon
C - Joinery	Inside joiner work	6,321	2,867	Assumes 35% lighter construction than standard plywood
D - Hull Fit.	Hull fittings, steering, deck machinery…	6,760	3,066	Standard equipment for an 80' yacht
F - Mach.	Machinery (engines, shafting, prop, genset…)	5,408	2,453	Currently assumes a genset, to be discussed
G - Systems	HVAC, water, fuel, fire	4,056	1,840	Standard equipment for an 80' yacht
H - Elec.	Electrical (batteries, panels, wiring, electronics)	4,732	2,147	Assumes lithium-ion batteries
I - Outfit	Ground tackle, bosuns's stores, rafts, safety..	4,056	1,840	Standard equipment for an 80' yacht
J - Soak	Allowance for water in the bilges	135	61	
K - Paint	Allowance for paint	859	390	
E - Spars	Masts (masts, booms, rigging)	6,023	2,732	Carbon spars with rod rigging, very rough number for now
Margin	General margin applied to vessel	3,033	1,376	
Wt. no Ball.	Weight fo the vessel with no ballast	63,694	28,891	
Ballast	Ballast, typically in keel	32,000	14,515	Starting point ballast - see study below
Light Ship	Lightship	95,694	43,406	
1/2 Ld. Items	Items added to obtain the half load condition	7,269	3,297	Assumes 50% of 400 gallons water, 600 gallons fuel
Half Load	**Condition used for preliminary review**	**102,963**	**46,704**	

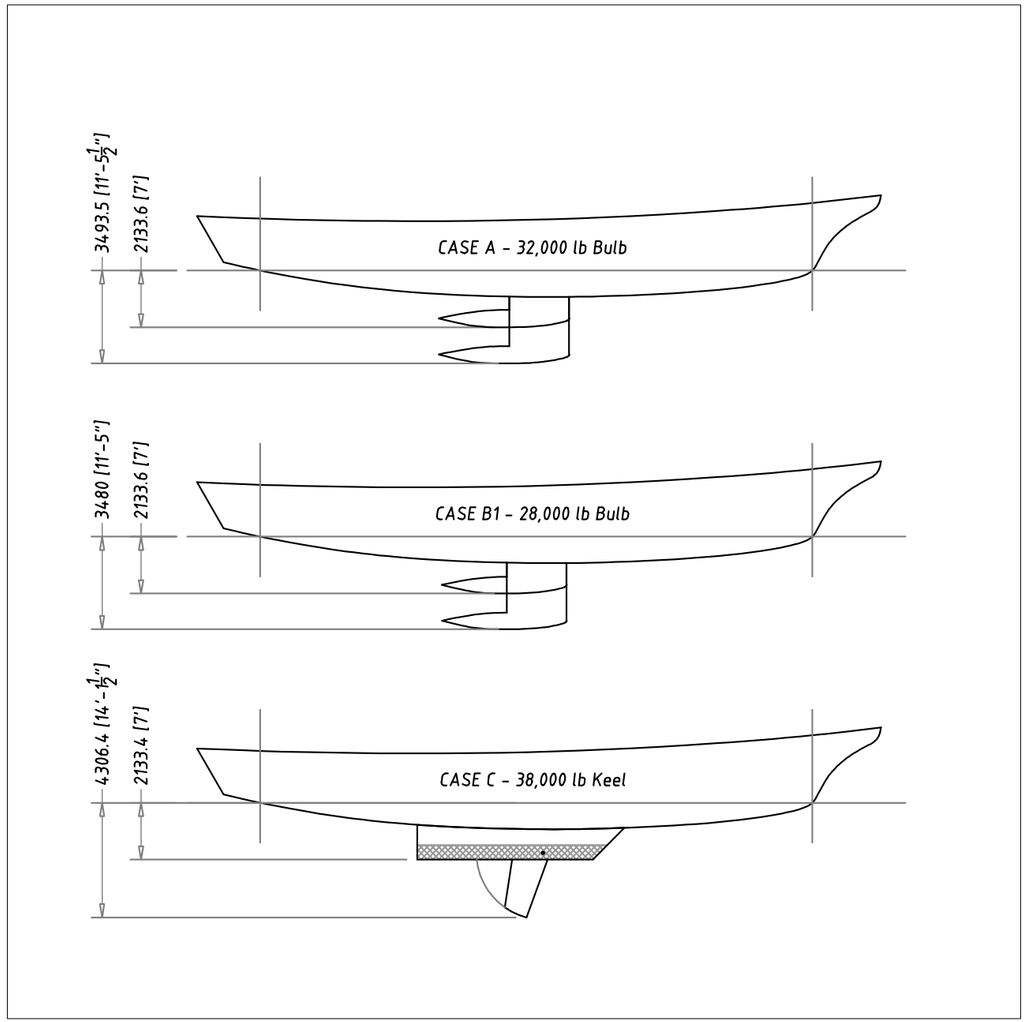
Alternate Keel Configurations

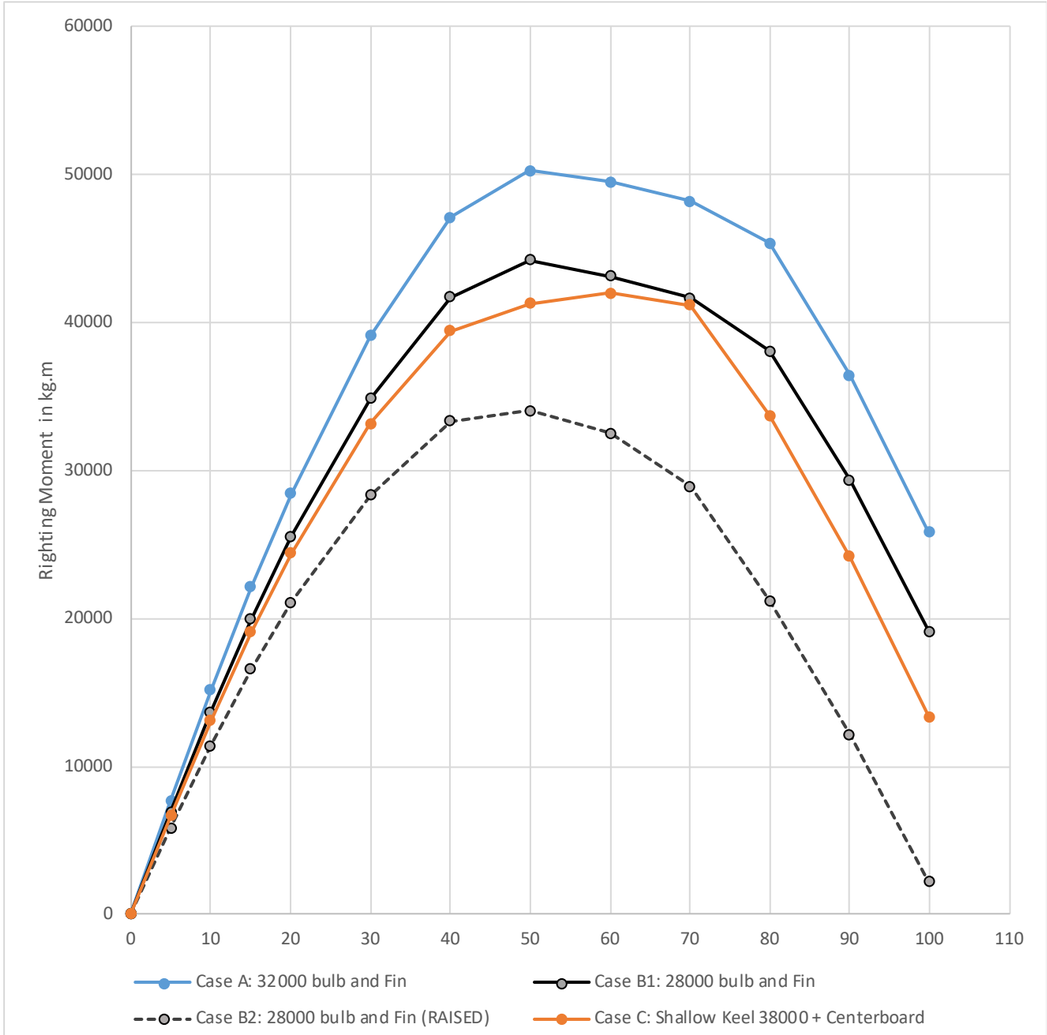
The 32,000-lb keel chosen as the base case was selected based on other known designs and a target RM1 (righting moment at 1 degree) of approximately 1,500 kg-m. This keel weight represents a starting point. Two other cases were examined: a lighter 28,000-lb keel, and a heavier 38,000-lb low aspect ratio keel.
Each of these three configurations were examined for both stability (see chart on this page), and for performance (see following pages).
Although the righting moment curves below don't mean much on their own they do show that case A provides the most stability (higher capacity to carry sail), case B shows a 10% drop in rghting moment at 20 degrees, and case C shows a 14% drop at the same heel angle, all relative to case A.

The other important conclusion is that in case B, with the keel raised, the vessels maintains adequate stability while motoring.

Half load displacements:

Case A:	46,704 kg	(102,963 lbs)
Case B:	44,889 kg	(98,962 lbs)
Case C:	49,425 kg	(108,962 lbs)

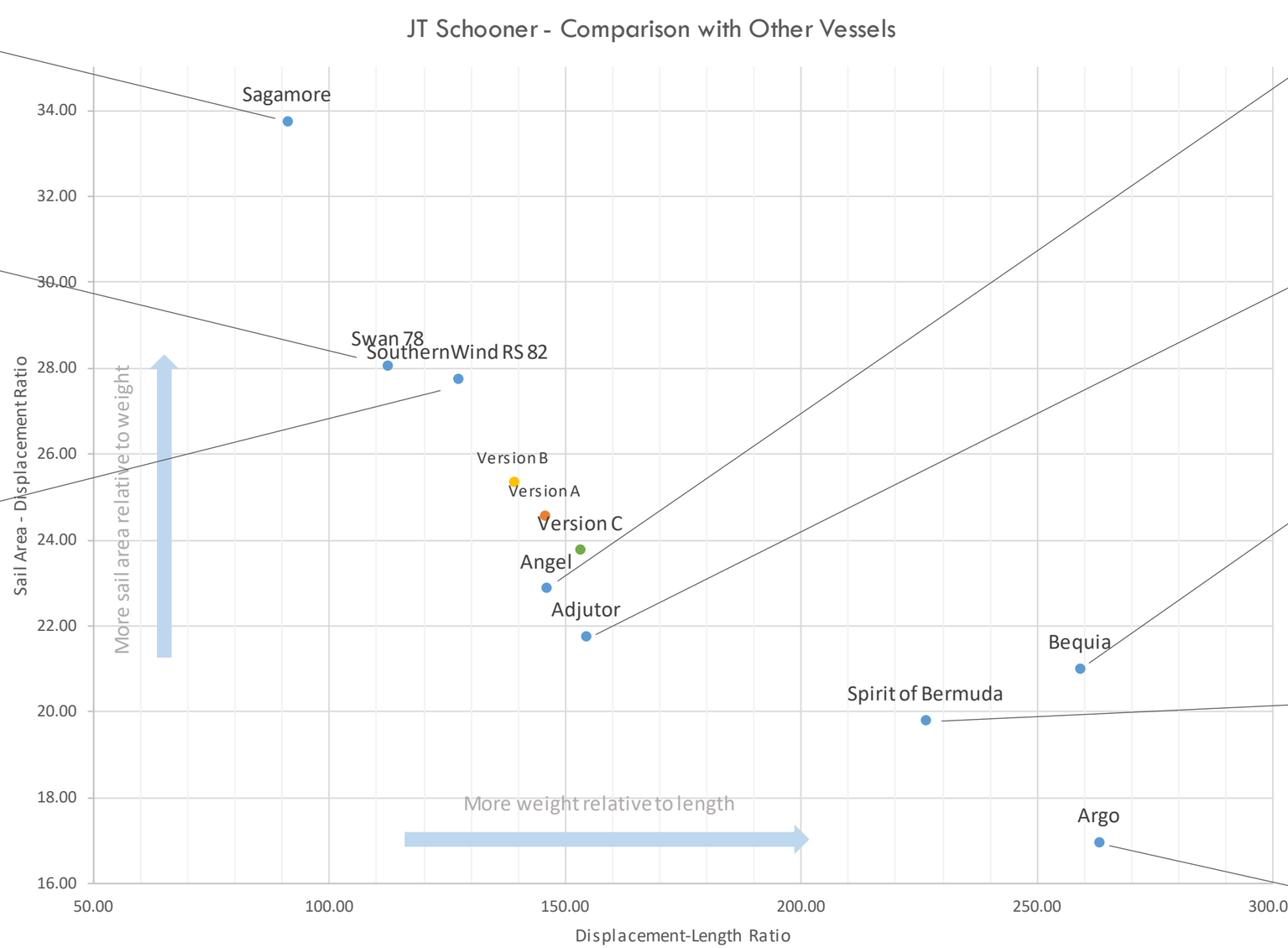




Comparison with other vessels

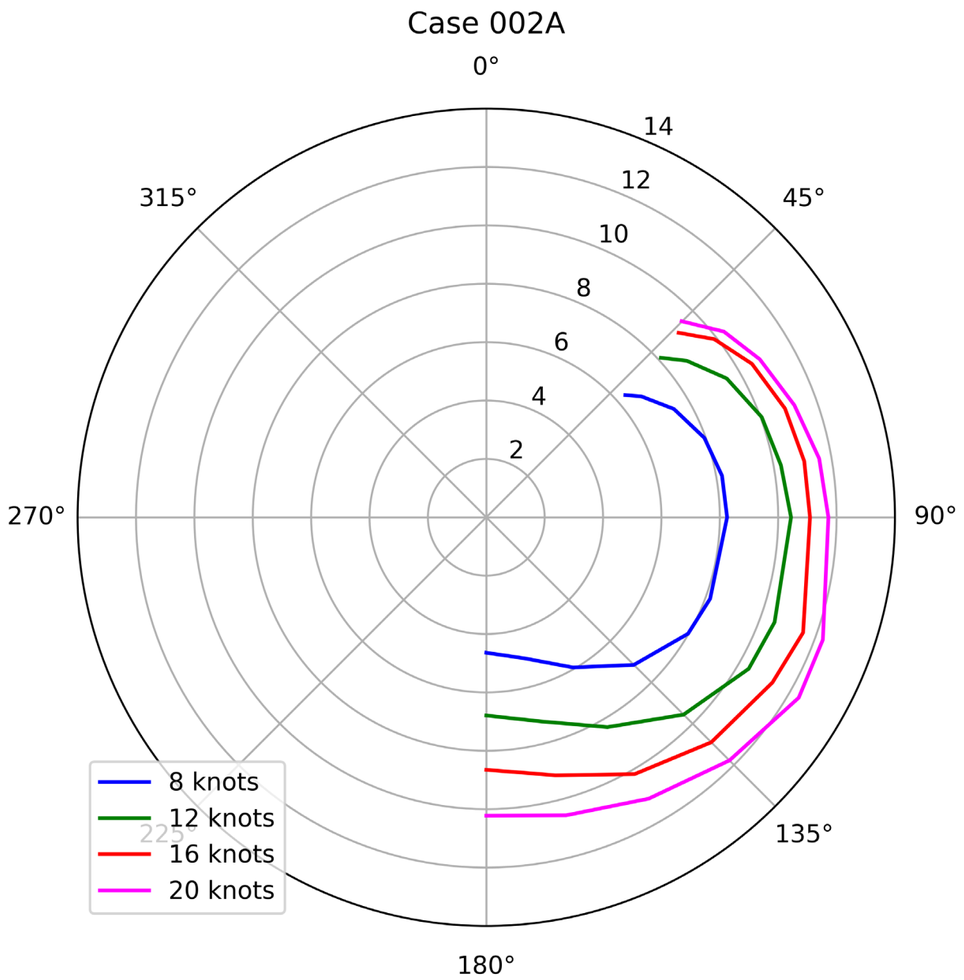
The chart below compares the preliminary design configurations with other boats. The purpose of this chart is to illustrate where both the vessel's displacement and sail area sit relative to other known vessels.

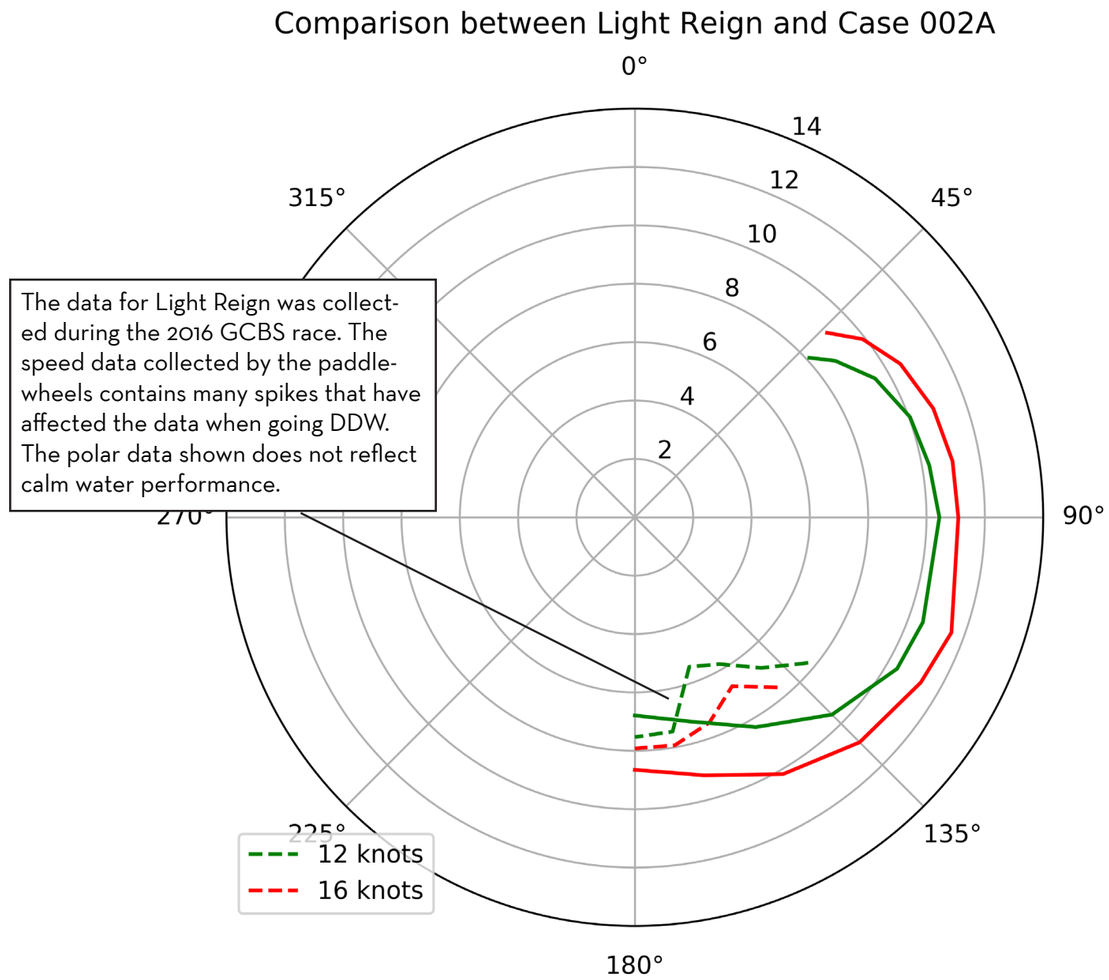
A note on sail area: currently the sail area being considered is approximately 315 sq.m (3,390 sq.ft) which is on the larger side. This area does not include the fisherman sail, and is likely to be adjusted as the design firms up. At issue is how quickly the vessel is likely to reef, which in turn will depend on the keel configuration.



Preliminary VPP Investigations

The following polar plots were developed assuming the previously described cases using the ORC VPP, version 2015. This VPP allows reasonalby accurate comparison between similar vessels but does not represent the most reliable performance prediction, in particular for cases that are not “plain vanilla”. The schooner rig and the potential for a low aspect ratio keel and centerboard are both pushing the limits of this particular VPP. Further studies will allow for a more in-depth performance prediction.





Preliminary VPP Investigations - Comparison

VERSION A - DEEP FIN + BULB
Displacement = 102,963 lb

TWA	VMG
deg	*knots*
47.6	5.46
148.7	7.19

TWA	BSP	Heel
deg	*knots*	*deg*
60	9.51	15.1
90	10.44	17.6
120	10.38	12.2
150	8.3	5.9
180	6.79	

VERSION B - DEEP FIN + BULB
Displacement = 98,962 lb

TWA	VMG	vs. A
deg	*knots*	*knots*
47.8	5.47	0.01
148.4	7.23	0.04

TWA	BSP	vs. A
deg	*knots*	*knots*
60	9.55	0.04
90	10.47	0.03
120	10.43	0.05
150	8.34	0.04
180	6.81	0.02

VERSION C1 - SHALLOW KEEL
Displacement = 108,962 lb
Centerboard UP

TWA	VMG	vs. A
deg	*knots*	*knots*
50.4	4.9	-0.56
149.5	7.16	-0.03

TWA	BSP	vs. A
deg	*knots*	*knots*
60	8.95	-0.56
90	10.22	-0.22
120	10.3	-0.08
150	8.27	-0.03
180	6.78	-0.01

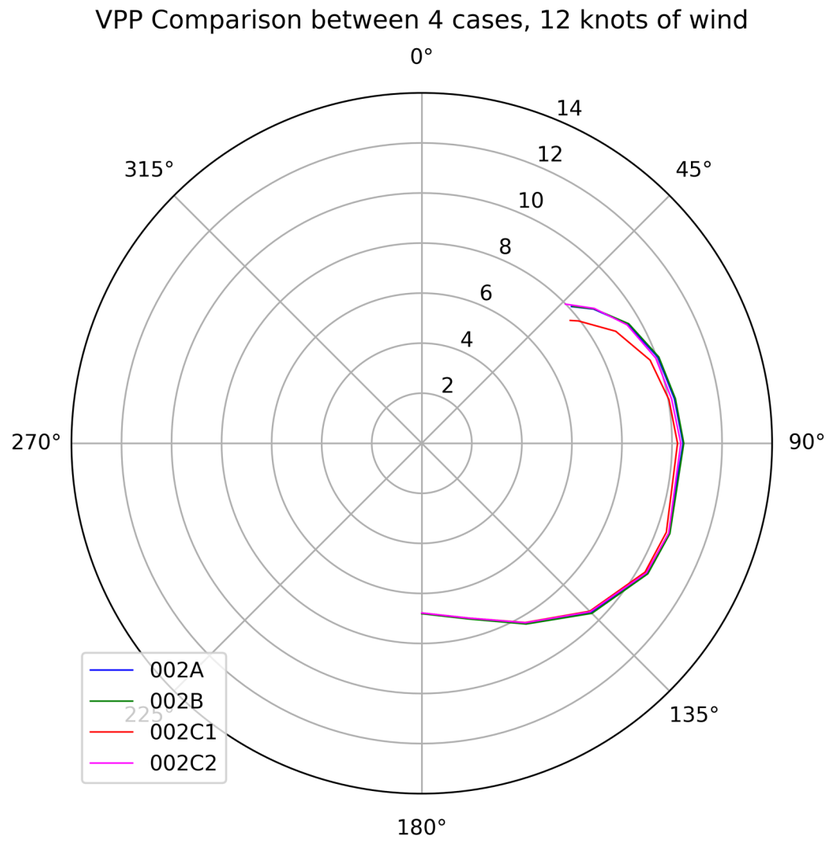
VERSION C2 - SHALLOW KEEL
Displacement = 108,962 lb
Centerboard DOWN

TWA	VMG
deg	*knots*
45.9	5.56
149.2	7.17

TWA	BSP	vs. A
deg	*knots*	*knots*
60	9.47	-0.04
90	10.35	-0.09
120	10.36	-0.02
150	8.28	-0.02
180	6.78	-0.01

Wind Averaged Seconds per mile, circular random course

		vs. A			vs. A			vs. A
6 knots	777.3		6 knots	773.8	-3.5	6 knots	816.4	39.1	6 knots	779.5	2.2
12 knots	456.9		12 knots	455.9	-1	12 knots	481.7	24.8	12 knots	456.2	-0.7
20 knots	360.5		20 knots	361.8	1.3	20 knots	383.4	22.9	20 knots	361.4	0.9



Next Steps for Performance Analysis

- Define operating parameters: minimum sailing draft, maximum sailing draft, minimum motoring draft
- Advance weight tally based on actual layout, 3D geometry and preliminary equipment list
- Advance preliminary hull construction to narrow down structural weight
- Investigate lifting keel mechanism to establish proper weight and geometry
- Establish performance criteria for future VPP and potential CFD work
- Examine stability characteristics compared to existing standards (ISO, Bermuda Race)