



V23.1

Course Design & Management since 2009

A MS Excel® based app for Race Officers and Course Setters

Part of the race management resources of...



Trapezoid

Windward Leeward

Optimist

Yacht Club

RS:X Slalom

505 Worlds

Triangle

Lipton Cup

Calculator

User's Manual

February 2023

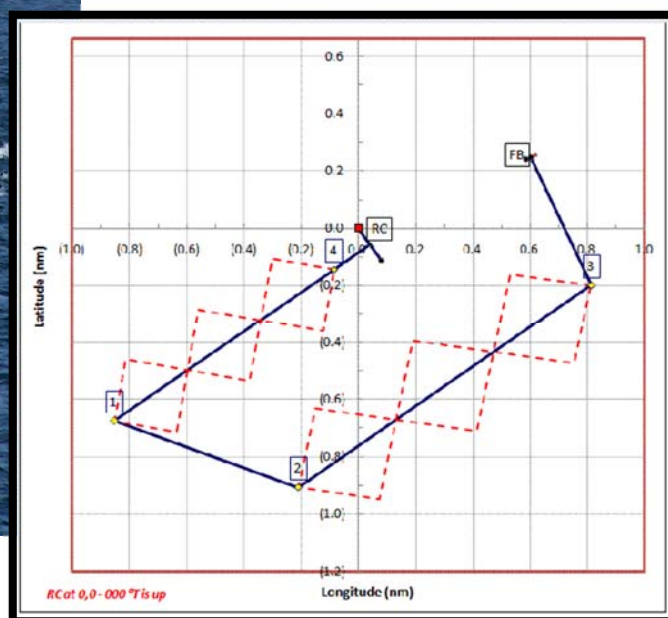


TABLE OF CONTENTS

1.	What is ezTrap ?	1
2.	Why use ezTrap ?	2
2.1	Going Digital	2
2.2	Key Benefits	2
3.	Getting Started with ezTrap	4
3.1	Organization of this Manual	4
3.2	Families and Course Variations	4
3.3	Features by Course	4
3.4	Ease of Use	6
3.5	Checklist	6
3.6	Working with Microsoft Excel®	7
3.6.1	Security	7
3.6.2	Data Validation	8
3.6.3	Excel® Data Entry Notes	8
3.6.4	Saving ezTrap Files	8
3.6.5	Course Display Export Function	9
3.6.6	Printing from ezTrap	9
3.6.7	Remote Access and Emailing Results	9
3.6.8	Source Code and Passwords	9
3.7	Index of ezTrap Courses	10
3.8	Latitude/Longitude Calculator	11
3.9	ezTrap Course Display	11
3.10	Header Information	13
3.10.1	Name and Sequence of Courses	13
3.10.2	Index Arrow	13
3.10.3	Export Arrow	13
3.10.4	Key Dates and EXPIRED Message	13
3.10.5	Version Number	13
3.10.6	Reset, Make Grid Square, Display or Hide Notes and Templates Buttons	13
3.10.7	Logo	13
3.11	Input Values	13
3.11.1	Magnetic Wind Direction (000-359 °M)	14
3.11.2	Variation (0-60 Degrees, E-Easterly or W-Westerly)	14
3.11.3	RC Boat Latitude & Longitude	15
3.11.4	Fleet Input Values	15
3.11.5	Course Type	16
3.11.6	Alignment of Marks with Start Line (Pin or MidPt)	16
3.11.7	Turning Mark Offset from Start Line (0-6,076)	16
3.11.8	Included Angle at Mark 1 (45-90°)	16
3.11.9	Start-Line Length Factor (100-150%)	16
3.11.10	Additional Input Values	17
3.12	Course Plot	17
3.12.1	Course Plot Orientation	17
3.12.2	Plot: Course and Marks	17
3.12.3	Plot: 3-Tack Boxes	17
3.13	Reset and Make Grid Square Buttons	18
3.14	Mark Information	18



3.14.1	RC Bearings and Distances to Marks	18
3.14.2	Latitudes & Longitudes of Marks	18
3.15	Course Information	19
3.15.1	Headings	19
3.15.2	Course Lengths (NM)	19
3.15.3	Point-of-Sail Statistics	19
3.15.4	More on Distance Sailed	19
4.	Trapezoid Courses (Trapezoid and Trap6)	20
4.1	Trapezoid Input Values	21
4.1.1	Course Plot Orientation – Wind Direction or North	21
4.1.2	Finish Leg Distance (0.05-6,076)	21
4.1.3	Outer/Inner Spacing Factor (50-250%)	21
4.1.4	Ratio of Reach to 1 st Leg Length (Calculated %)	21
4.2	Trap6 Input Values	22
4.2.1	Finish Leg Angle (45-135 °) - Trap6 Only	22
4.2.2	Finish Leg Distance (0.05-6,076)	22
4.2.3	Outer/Inner Spacing Factor (50-250%)	22
4.2.4	Ratio of Reach to 1 st Leg Length (Calculated %)	22
4.2.5	Mark 1a Offset (Trap6)	23
4.3	TRAP6 Templates (Simple Excel® Worksheets with Marks & Course Information)	23
5.	RS:X Windsurfer Slalom Courses (RSXtrap & RSXls)	25
5.1	RSX Input Values	25
5.1.1	Course Type	25
5.1.2	Initial Slalom Angle (10-30 °)	26
5.1.3	Mark Offset from Start Line (0-6,076)	26
5.1.4	Slalom Leg Distance (0.05-6,076)	26
5.1.5	Outer/Inner Spacing Factor (50-250%)	26
5.1.6	Ratio of Reach to 1 st Leg Length (Calculated %)	27
6.	Optimist Course (Opti)	28
6.1	Optimist Course Input Values	28
6.1.1	Finish Leg Distance (50-150% of third leg)	28
7.	Windward/Leeward Course (W/L)	29
7.1	Windward/Leeward Course Input Values	29
7.1.1	Course Types	29
7.1.2	WL-3, WL-5 & WL-7 Finish Leg Distance (20-150% of W/L Leg)	29
8.	Yacht Club Course (Club)	30
8.1	Club Course Input Values	30
8.1.1	Course Name	30
8.2	Pre-defined Fixed Marks Table	30
8.2.1	Fixed Mark ID	31
8.2.2	Fixed Mark Name	31
8.2.3	Fixed Mark Latitude and Longitude	31
8.3	Yacht Club Course Table	31
8.3.1	Calculated Legs ('C')	31
8.3.2	Fixed Legs ('F')	31
8.3.3	Roundings	32
8.3.4	Course Information	32



8.3.5	Point-of-sail Statistics	32
9.	Triangle Course (Triangle)	33
9.1	Triangle Course Input Values.....	33
9.1.1	Course Types (Tri-2, Tri-3 or Tri-4).....	33
9.1.2	Tri-4 Finish Leg Distance (0.05-6,076)	33
10.	505 Worlds Course (505)	34
10.1	505 Worlds Course Input Values	34
10.1.1	Course Types (DV-7 and DV-8).....	34
10.1.2	Gate Start or Start Line.....	34
10.1.3	Mark 1 Included Angle.....	34
10.1.4	505 Marks.....	34
11.	Lipton Challenge Cup Courses (R, T, O, and S).....	35
11.1	Rectangular Lipton R Course Input Values	36
11.1.1	LiptonR Course Types.....	36
11.1.2	LiptonR Reach to W/L Leg Ratio (50-150%).....	36
11.2	Lipton Triangle T and O Course Input Values	36
11.2.1	LiptonT Course Types.....	36
11.3	Lipton Windward/Leeward S Course Input Values.....	37
11.3.1	LiptonS Course Types	37
11.3.2	LiptonS Course Finish Leg Distance (20-150% of W/L Leg)	37
12.	ezTrap Support.....	38
12.1	Registered User Requirement Eliminated.....	38
12.2	On-going Development and Support TBD	38
12.3	Compatibility with Older Versions of Excel®	38
12.3.1	Mac OS	38
12.4	Version History	38
12.5	Acknowledgements	40
12.6	About the Developer	40
12.7	Disclaimers	40
13.	Glossary of Terms.....	41



1. What is ezTrap ?

ezTrap is a Microsoft Excel®-based spreadsheet application for sailboat racecourse design and management, and is typically used to assist the Principal Race Officer (PRO) or other Race Officers in real time when setting a course as well as making any adjustments during a sailboat race. It does not replace the need for a competent Race Officer, but it greatly speeds up the process and helps optimize the value of the race by providing many course related calculations instantly and accurately, especially the Latitudes & Longitudes of all marks and pins.

ezTrap was originally developed in 2009 by Ed Bottrell in Halifax, Nova Scotia, Canada to support the setting of windward/leeward and trapezoid shaped racecourses for local, regional, national, and international regattas. It soon drew international attention and was enhanced and expanded over the next decade to support most of the dinghy and keelboat racecourse shapes in common use around the world.

Until 2019, the funding for the development, enhancement, distribution, and support of ezTrap was covered by a one-time modest fee that allowed unlimited use by groups such as yacht clubs, Race Officers, and one-design associations. In late 2020 ezTrap was given to [Sailwave](#) as a new part of their race management resources.

[Trapezoid](#)[Windward Leeward](#)[Optimist](#)[Yacht Club](#)[RS:X Slalom](#)[505 Worlds](#)[Triangle](#)[Lipton Cup](#)[Calculator](#)

SUGGESTED IMPROVEMENTS TO THE DOCUMENTATION

Please point out any sections within this guide that are incorrect, out of date, or inadequate in some way, by sending suggestions to Huw Pearce using the Sailwave User Group [SUG] ezTrap Support Forum at <https://forum.sailingresults.co.uk/c/eztrap-support>, referencing the page or section in question, along with wording for the suggested improvement, correction or addition. Alternatively send an email to huw@sailwave.com.



2. *Why use ezTrap?*

2.1 *Going Digital*

The advent of inexpensive marine GPS devices and computers on board has provided significant opportunities to improve the sport of sailboat racing. Without a doubt, the use of GPS has improved the quality of racecourses because of the availability of key information such as the bearing and distance from another object (e.g., RC Signals Boat), which makes setting a typical windward/leeward (W/L) course relatively simple. With a little bit of homework, even a trapezoid course can be set by simply using range & bearing information.

However, the challenges can quickly mount with changes in racing conditions, wind direction, dissimilar fleets on the same course, and getting to acceptable Target Race Times. ezTrap not only solves these challenges and more, but also provides instant Latitudes & Longitudes for all marks and pins, which are key data elements for accurate and precise GPS navigation.

ezTrap was developed and became available in 2009. It is unique in its integrated capabilities for designing sailboat racecourses and is being used by Race Officers (ROs & PROs) and Course Setters for local, regional, national, and international regattas in more than 15 countries around the world.

ezTrap operates on any computer that supports the full implementation of Microsoft Excel® including some Apple Macs. Computer technology and Internet connectivity continue to develop rapidly, and as such it is expected that a multitude of devices including tablets and smart phones, or similar systems will be capable of supporting Microsoft Excel® and therefore ezTrap in the future.

2.2 *Key Benefits*

- **Short Design Time:** In sailboat racing, time is a critical success factor for setting and changing the course. Once the RC Signals Boat is in position and the Wind Direction determined, an ezTrap course can be designed (or re-planned) within seconds to meet the Target Race Time. The complexities of designing Trapezoid and other courses are minimized.
- **Accuracy and Precision:** ezTrap was built using Microsoft Excel®, which accurately calculates Latitudes and Longitudes (using spherical trigonometry), leg lengths, angles, times, etc. to a very high precision. Using simple Input Values, ezTrap instantly makes the complex calculations and displays the results. ezTrap has been validated to be accurate and precise; for example, Latitudes and Longitudes are displayed to the nearest 0.001' or about 6-10 Feet.
- **Faster Set-up and Change Time:** Again, time is of the essence when setting or changing a course. ezTrap not only provides Range and Magnetic Bearings to/from each Mark it also provides Latitudes & Longitudes, allowing Mark Boats (equipped with GPS) to quickly find the proper mark position. Further, multiple marks can be set (or reset) concurrently instead of serially. The Range and Bearing information can be useful for ROs and/or Mark Setters with hand-held compasses; however, the real-world results are considerably less accurate because of the difficulty in getting a hand-held bearing in a rocking boat.
- **Optimization:** ezTrap provides several embedded algorithms that automatically optimize characteristics of the racecourse including calculation of the ideal W/L and Reach leg length(s) to meet the Target Race Time(s) and desired fleet spacing.
- **Uniform High Quality:** The essential geometry of each ezTrap course is predefined to international standards where they exist, and repeatable anywhere in the World to meet consistent high-quality expectations.



- **Flexibility:** Numerous Input Values are available for designing (and tweaking) most ezTrap courses to meet the capabilities of the fleet(s), current racing conditions, Target Race Times, RC/mark boat resources, and objectives of the RO.
- **Confidence:** ezTrap greatly reduces the likelihood of human error and provides a high degree of confidence in the squareness, integrity, and high quality of the course, which is especially important for championship racing.



3. *Getting Started with ezTrap*

ezTrap is a sophisticated MS Excel® app with many worksheets; however, the user only needs to work with a single, easy-to-use worksheet for any one of the courses. Also, a separate tab of relevant notes is provided for each course for quick reference.

3.1 *Organization of this Manual*

The User's Manual has three basic parts:

- Getting Started section that explains the basics common to all ezTrap Course Families;
- Separate sections for each of the Course Families and their unique characteristics; and,
- Support section including a Glossary of Terms.

3.2 *Families and Course Variations*

The ezTrap v23 bundle is composed of four families of 12-courses, each of which may have several variations.

- Trapezoid, Optimist, and RS:X Slalom
 - o **Trap6** (a 6-leg partial trapezoid that can support up to 3-concurrent fleets)
 - o **Trapezoid** (a 7-leg trapezoid that can support one or two fleets)
 - o **Opti** (USODA and IODA Optimist courses)
 - o **RS:X Trap** (1, 2 and 3 times around slalom courses)
- Windward/Leeward, Lipton "S", and RS:X LS Slalom
 - o **WL & LiptonS** (5- course variations)
 - o **RS:X LS** (3-course variations)
- Triangle, Lipton Triangle 'T', 'O' & 'R'
 - o **505 Worlds** (triangle + W/L courses with 'Rabbit' starts)
 - o **Triangle** (3-course variations)
 - o **LiptonT** (equilateral courses with 3-variations)
 - o **LiptonO** (isosceles triangle course)
 - o **LiptonR** (rectangular course with 3-variations)
- Yacht Club – Custom Design
 - o **Club** (completely DIY courses with up to 12-legs each using fixed and/or moveable marks)

In addition to the course families and variations ezTrap also has a **Calculator** function that can be used at any time and independent of any course. The Calculator will enable the end user to go back and forth from Magnetic and True headings and perform two basic calculations involving Latitude & Longitude.

3.3 *Features by Course*

The features of each course family are shown on the next page.



ezTrap v21.1 Families & Features	Trapezoid & Trap6 w/1a	Windward Leeward	Optimist	RS:X Slalom Trap & LS	Yacht Club (Custom)	505 Worlds & Triangle	Lipton Cup
<i>Courses</i>	2	1	1	2	1	2	4
<i>Variations</i>	3	5	2	6	variable	5	10
Adjustable Finish Leg	✓	✓	✓	✓		✓	
Adj. Start/Finish Line Lengths	✓	✓	✓	✓	✓	✓	✓
Adj. Tack Angle w/Leeway	✓	✓	✓	✓	✓	✓	✓
Calc. Mark Locations within 10' (3m)	✓	✓	✓	✓	✓	✓	✓
Course Graphic to Scale (NM)	✓	✓	✓	✓	✓	✓	✓
Custom Course Design					12-Legs		
Fixed Marks Support					21-Marks		
Global Lat's, Long's & Variance	✓	✓	✓	✓	✓	✓	✓
Leg & Cumulative Time	✓	✓	✓	✓	✓	✓	✓
Leg & Distance Sailed (NM)	✓	✓	✓	✓	✓	✓	✓
Leg HDGs & BRGs	✓	✓	✓	✓	✓	✓	✓
Magnetic & True Directions	✓	✓	✓	✓	✓	✓	✓
Mark Latitudes & Longitudes	✓	✓	✓	✓	✓	✓	✓
Mark to/from RC BRGs & Distance	✓	✓	✓	✓	✓	✓	✓
Metric Support	✓	✓	✓	✓	✓	✓	✓
Pin or Mid-point Course Alignment	✓	✓	✓	✓		✓	✓
Point of Sail Avg. Speed Support	✓	✓	✓	✓	✓	✓	✓
Point of Sail Statistics	✓	✓	✓	✓	✓	✓	✓
Start Line Offset Mark	✓	✓		✓		✓	✓
Target Race Time Re-Sizing	✓	✓	✓	✓		✓	✓
Third Fleet Support – Inner Mk1a	✓						
Excel® Templates for Smartphones	Trap6						
Two Fleet Support w/Adj. Spacing	✓			✓			
Variable Angle at Mark 1	✓			✓	✓	✓	



3.4 *Ease of Use*

Most people will find ezTrap easy to use. The initial view can be intimidating because of the significant amount of information in the display. However, the information is broken down into six blocks, of which only one (Input Values) requires user input – the rest are the results of the ezTrap calculations:

- **Header:** The information at the top of the display is primarily for reference. It also includes a clickable arrow that returns the user to the main Index of courses, and clickable buttons that adjust the course display and activate the Notes tab.
- **Input Values:** This block contains all the variable parameters that the user keys in to define the course. It also contains a few calculated values such as the Start & Finish Line lengths. Once the input values have been entered and refined, the course is designed and ready for use. Typically, the user only changes the Input Values when the course needs to be shifted or redesigned.
- **Mark Information:** Contains the information for setting the marks, offsets, and Finish Boat locations. The user cannot change any of these values directly; only by changing the Input Values.
- **Course Information:** Contains the leg-by-leg attributes of the course(s) including POS, lengths, times, and headings. The user cannot change any of these values directly; only by changing the Input Values.
- **POS Stats:** The distance and time sailed by Beat, Run, and Reach are shown along with the percentages for the course(s). The user cannot change any of these values directly; only by changing the Input Values.
- **Course Display:** The graphical display of the course, legs, and marks, is shown on an X-Y (Longitude-Latitude) grid. Each course has the option to make the plot orientation 'Wind-up' or 'North-up'. The plot grid is relative with the RC Boat at 0,0 and sized in NM. The course display is proportional to the local Chart when the 'Reset' button is clicked and made square (i.e., each grid is the same height and width) when the 'Make Grid Square' button is clicked. Again, the user cannot change the display directly; only by changing the Input Values.

Further, ezTrap includes a built-in calculator that works with latitudes, longitudes, bearings, and distances as well as converting Magnetic/True directions.

New features with V23 are:

- User controlled generation of TRAP6 Templates with different Target Race Times and relative bearings and distances to/from the RC and marks. The templates can also be used on Smartphones that support simple Excel® spreadsheets.
- Course plot orientation option of 'Wind-up' or 'North-up'.
- Expansion of Club Course fixed marks from 12 to 21.

3.5 *Checklist*

It is highly recommended that new users completely familiarize themselves with the Course(s) they plan to use, and to practice changing the Input Values and observing the various effects. The following add-on checklist is suggested to help ROs plan and execute an ezTrap course:

- Pre-planning
 - Review NOR, SI, etc. for any special requirements
 - Determine the starting-point parameters for the fleet(s) such as probable location of RC-Signals Boat, expected size of the course and potential interferences, number of boats, average LOA, average boat speeds (i.e., beat, run, and reach) given expected wind conditions, tidal or other currents, etc.
- Computer:
 - Appropriate PC with a screen size and view-ability for the conditions expected
 - Adequate battery life or access to compatible AC/DC power
 - Printer, if hard copy is required



- o Current version of ezTrap in the correct file format (.xlsm)
 - o Up to date version of MS Excel® with macros enabled
 - o This User's Manual and/or pre-printed 'Notes' from the course(s) may be helpful.
- RC-Signals and Mark Boats
 - o GPS, chart, or chart plotter
 - o Communications (e.g., VHF, GMRS/FRS, Cell)
 - o Mark setter and crew training. Note that ezTrap provides a quick refresher entitled "Essentials of Navigation", which is available for free download from the website.

3.6 Working with Microsoft Excel®

ezTrap was developed using Microsoft Excel® 2010 and will work with Excel® 2007, 2013, 2016 or MS 365 without any technical modifications or additions. Please note that ezTrap is no longer available in the Excel® 2003 or earlier formats (.xls).

ezTrap is self-contained and does not require access to any external programs or data to operate. It does contain user-controlled Visual Basic for Applications (VBA) macros that support the following:

- Reset and Make Grid Square graphical plot of the course;
- Navigation to specific courses and return to the Index with single clicks;
- Creation of TRAP6 course templates as a separate workbook;
- Creation of a separate workbook containing the current Course Display values;
- Toggle the display of Course Notes; and,
- Display or hide all courses.

To work properly, macros must be enabled on the user's computer.

ezTrap also has hyperlinks to [Sailwave.com](https://www.sailwave.com) and the [National Oceanic and Atmospheric Administration \(NOAA\) website for magnetic declination \(i.e., Variation\)](https://www.noaa.gov/magnetic-declination). The macros and hyperlinks are explained further in the sections that follow.

Microsoft Excel® is a feature rich and complex software environment that can be utilized by people of all skill levels. Although ezTrap makes use of sophisticated features and functions, every reasonable effort has been made to keep the user-interface simple and easy to use.

The following tips and techniques may be helpful.

3.6.1 Security

ezTrap utilizes several levels of security. Each course and 'Notes' worksheets (tabs) use Worksheet Password Protection to prevent the user from accidentally changing fixed or calculated values while allowing the user to change Input Values at will.

Workbook and Macro Password Protection, and hidden worksheets are utilized to prevent the user from changing any of the underlying formulae, constants, or structure.

***Note:** You may need to change your Trust Center Settings to enable macros... use Office Button, Excel Options, Trust Center, Settings, Enable all*



3.6.2 Data Validation

Excel's Data Validation function is utilized for many Input Values to ensure that the data entry is valid and appropriate. In some cases, a Data Validation Message will pop-up to describe the expected range of values to be input. For example, N or S Latitude is restricted to values between 0° and 88° 59.9999'.

In some cases, otherwise valid Input Values may create an impossible or unreasonable course, which may also be apparent on the Course Plot. ezTrap identifies many of these conditions and provides a warning message (e.g., **Warning - Unreasonable Course Parameters**) and highlights the relevant information.

3.6.3 Excel® Data Entry Notes

Input Values may be entered with a keyboard followed by the 'Enter' key. Some Input Values can also be entered from a pull-down menu by left clicking on the field, then left clicking on the desired value. Information can also be entered using the MS On-Screen Keyboard (osk.exe).

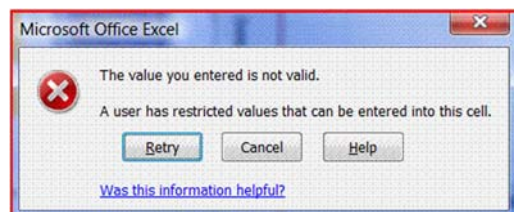
Mark 4 Spacing
Enter spacing between
Start Line and Mark 4.
Decimal number
between 0-6,076 feet,
Meters, or nm

- **Message:** Many ezTrap input fields have a message that pops up when the cell is selected. These can often obscure other information nearby but can be moved by left clicking & holding the cursor over the message then sliding it to an out-of-the way position on the screen. The messages will stay in the new position until ezTrap is restarted.
- **Pull-Down List:** Some input fields have pre-established values that can be selected by cursor or entered by keyboard. When a cell having a Pull-Down List is selected, a little box with a down-arrow appears – clicking the arrow will display the valid choices, which can be selected with the cursor.
- **MS Excel® Error Messages:** Some fields have data validation to ensure that input value falls within an acceptable range or conforms to valid choices. If the error message pops up, the user should click re-try and re-enter valid information or click cancel. Note that the Pull-Down List may not work properly during re-try. Alternatively, pressing 'Esc' should return the field to the previous value.
- **Lower Case Letters:** There is no specific support for lower case letters (e.g., Variation – E or W, Latitude – N or S, or Longitude – E or W). Please enter the upper-case letters or choose from the Pull-Down List.
- **Percentages:** Fields such as Inner/Outer Spacing are formatted as percentages and accept input as a percentage. For example, with the cell selected, the sequence 125 can be entered with or without the '%' symbol for 125%. However, after some data entry problems, Excel® will expect a decimal number, and not a percentage. If that happens, then either '125%' or '1.25' should produce the same result. Be sure to check the resultant number. Also, pressing 'Esc' should return the field to the previous value.
- **Distance Measures - Nautical Miles, Metres, and Feet:** ezTrap supports data entry of some fields using Feet (Ft.), Metres (m) or Nautical Miles (NM). Note that 1.0 NM = 6,076 ft. A simple metric conversion table is provided in several places in this manual and on the 'Notes' page of each course to help the user with conversions.

NM	Metres	Feet
1.00	1,852	6,076
0.02	30	100
0.08	152	500
0.16	305	1,000
0.03	50	164
0.05	100	328
0.08	150	492
0.05	93	304
0.10	185	608
0.15	278	911

3.6.4 Saving ezTrap Files

The user may save files in a normal manner - ezTrap will not stop the user from saving or copying files. However, ezTrap does use the filename (bottom left corner) and current date (bottom right corner) when printing the display. Note that the Input Values are retained when the file is saved, and not reset when restarted.



The user may want to save one or more variations of a course as the design evolves or changes, or as a record of what was used for an event. One suggested approach is to vary the filename utilizing the current date & time such as: '2017 04 07-1445 ezTrap Opti Nationals.xlsm'.



Some users save 'master' or 'template' files with pre-set parameters such as the Fixed Mark Table and/or Course Definitions for the Yacht Club Course. This can be very useful for a RO to select from many options depending on the current racing conditions.

3.6.5 Course Display Export Function

Further, the 'Export' function will create a separate standalone spreadsheet (.xlsx) of the current Course Display with formatting, values only, and a picture of the Course Plot. The exported Course Display can be used for printing or further processing of the information by the end user.

3.6.6 Printing from ezTrap

The user may print in the normal manner; however, the printouts are scaled for 1-page, Letter sized paper – Landscape or Portrait. Most printer drivers can be modified to scale up or otherwise print on different sized papers (e.g., A4).

Depending on other factors (e.g., version of MS Windows® and/or Excel®, availability of Adobe Acrobat, etc.) the user can also print to a file in a standard electronic format such as .xps – XML for Paper Specification, or .pdf – Adobe Portable Document Format for viewing or printing later. Your computer operating system and MS Excel® Help functions can provide more information on this topic.

3.6.7 Remote Access and Emailing Results

For those ezTrap users that have access to the internet and email coverage on the racecourse, there are several ways to send results to interested parties. A Shore-based or Master Course Setter with a PC and ezTrap can quickly build (or change) a course with the basic input values, then communicate the Mark Information to the ROs and Mark Boats.

In addition to verbal communication (e.g., radio or cell phone), the text of the Mark Information can be sent by email to ROs and Mark Boats with smart phones by simply swiping the information off the screen and pasting it into an email message or activating the Export Course Display function to create a separate spreadsheet. If the smart phones are capable, a printout of the course (see above) or the exported Course Display can be emailed.

Remote connection software is available (e.g., VNC) to allow any PC, Mac, tablet, or smart phone with access to the internet to access a PC running Excel® and ezTrap. Other networking solutions (e.g., WiFi) are also possible.

3.6.8 Source Code and Passwords

As mentioned above, ezTrap utilizes passwords and other security functions to prevent unwanted or accidental changes. Further, the download version has hidden worksheets where most of the formatting and developer notes have been removed. If a user has valid reasons for working with the un-locked and un-redacted source code, please contact Sailwave.

3.7 Index of ezTrap Courses

The first tab in the workbook is the Index of Courses (shown below) grouped in four families.

 Index of ezTrap Courses Lat./Long. Calculator Hide/Open all Courses			
v21.1 <i>Sailwave Race Management Resources</i>			
Course Name	Total	W/L Leg	Description
RS:X Trap	9	2	Once around RS:X Windsurfer Trapezoid Slalom course
	11	3	Twice around RS:X Windsurfer Trapezoid Slalom course
	13	4	Three times around RS:X Windsurfer Trapezoid Slalom course
Windward/Leeward, Lipton "S", and RS:X LS Slalom			
W/L & LiptonS	3	2	Once around Windward/Leeward Course with an upwind Finish at M1. Equivalent to the Lipton Challenge Cup S-1 Course with Pin alignment, 100% Finish Leg Distance, and zero offset.
	4	2	Twice around Windward/Leeward Course with a downwind Finish at start.
	5	3	Twice around Windward/Leeward Course with an upwind Finish at M1. Equivalent to the Lipton Challenge Cup S-2 Course with Pin alignment, 100% Finish Leg Distance, and zero offset..
	6	3	Three times around Windward/Leeward Course with a downwind Finish at start.
	7	4	Three times around Windward/Leeward Course with an upwind Finish at M1. Equivalent to the Lipton Challenge Cup S-3 Course with Pin alignment, 100% Finish Leg Distance, and zero offset..
RS:X LS	6	1	Once around RS:X Windsurfer W/L Slalom course
	8	2	Twice around RS:X Windsurfer W/L Slalom course
	10	3	Three times around RS:X Windsurfer W/L Slalom course
Yacht Club - Custom Design			
Club	12-legs max.		Suitable for Yacht Club Racing. Up to 12-legs. Custom built by using any combination of fixed or moveable marks. Up to 12-Fixed Marks are pre-defined in a table and can be used for any leg. Point of Sail Stats are calculated to help Course Planner balance
505 Worlds, Triangle, Lipton Triangle 'T', 'O' & 'R'			
505 Worlds	7	3	Triangle + W/L Course using Gate ("Rabbit") Start or Start-Line. Finish downwind.
	8	4	Triangle + W/L Course using Gate ("Rabbit") Start or Start-Line. Finish upwind.
Triangle	5	2	Triangle + W/L Course using the Start-Line Pin as the Leeward Mark & Finish
	5	2	Triangle + W/L Course with a short downwind Finish at the Start-Line.
	6	3	Triangle + W/L Course with a variable upwind Finish.
LiptonT	4	2	Once around Equilateral Triangle Course with an upwind finish at M1.
	7	3	Twice around Equilateral Triangle Course with an upwind finish at M1.
	10	4	Three times around Equilateral Triangle Course with an upwind finish at M1.
LiptonO	9	4	Isosceles Triangle + W/L Course, repeated again with an upwind finish at M1.
LiptonR	5	2	Once around Rectangular Course with an upwind finish at M1.
	9	3	Twice around Rectangular Course with an upwind finish at M1.
	13	4	Three times around Rectangular Course with an upwind finish at M1.



The Total legs, windward/leeward legs, and description are shown for each course. To help the user with selecting and using the proper course(s), there are several buttons to display or hide course and notes tabs:

- The yellow **Lat./Long. Calculator** button will immediately transfer the user to the **Calculator** tab, which is explained in the next section.
- The green **Hide/Open all Courses** button will hide or display all courses and notes.
- Clicking on the colored box with the course name will display the course tab. Clicking the colored box a second time will transfer the user to the course or the user can simply click on the tab to transfer to the course.
- Once a course tab is opened there is no provision to hide the individual course; however, the green **Hide/Open all Courses** button can be used to close all tabs.
- The user can display and switch to the notes associated with any course by clicking the green **Display or Hide Notes** button on any course tab. If the notes tab is already open, then clicking the green button will hide the notes tab.
- The user can return to the Index by clicking the red arrow labeled **Index** on any course tab.

Clicking any of these buttons in any sequence does not affect the data entered or results displayed for any course.

3.8 *Latitude/Longitude Calculator*

The built-in calculator for ezTrap provides four independent functions:

1. Converts a Magnetic compass reading ($^{\circ}\text{M}$) to a True direction ($^{\circ}\text{T}$) given the magnetic variation in the local area.
2. Converts a True direction to a Magnetic compass direction given the magnetic variation in the local area.
3. Calculates the Bearing ($^{\circ}\text{T}$) and Distance (NM) from point 1 to 2 given the latitude and longitude of points 1 & 2.
4. Calculates the latitude and longitude of point 2 given the latitude and longitude of point 1 and a Bearing ($^{\circ}\text{T}$) and Distance (NM) to point 2.

3.9 *ezTrap Course Display*

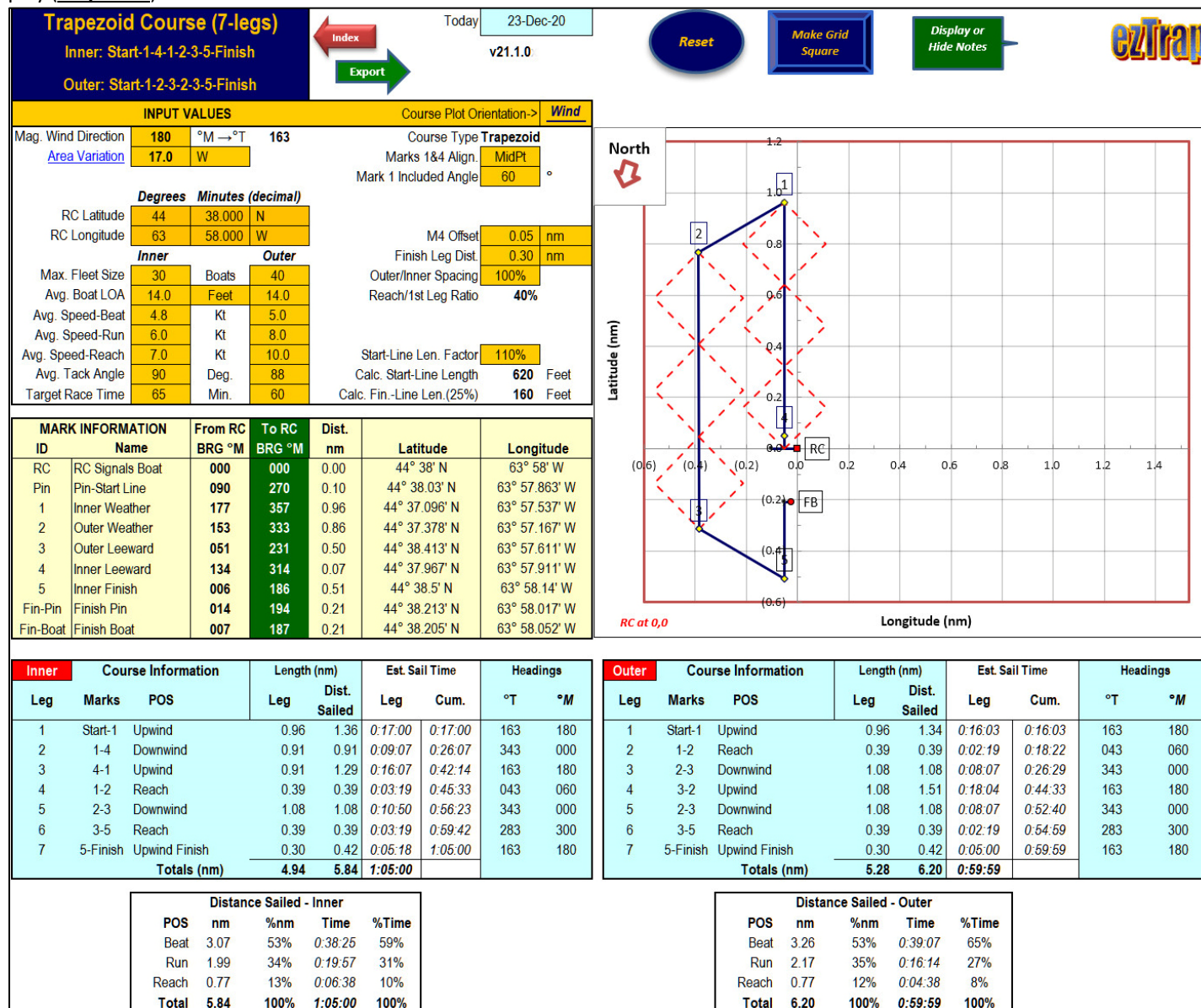
There are six areas on each display (see Trapezoid sample on next page) that are common to all courses and are explained in this section:

- Header
- Input Values
- Mark Information
- Course Information
- POS Statistics
- Course Plot.

Some Course Families have additional Input Values and display information that are further explained in the detailed sections of this manual. The following page shows a typical display (e.g., 7-leg Trapezoid).



ezTrap Course Display (Trapezoid)



Inner				Course Information		Length (nm)		Est. Sail Time		Headings	
Leg	Marks	POS	Leg	Dist. Sailed	Leg	Cum.	°T	°M			
1	Start-1	Upwind	0.96	1.36	0:17:00	0:17:00	163	180			
2	1-4	Downwind	0.91	0.91	0:09:07	0:26:07	343	000			
3	4-1	Upwind	0.91	1.29	0:16:07	0:42:14	163	180			
4	1-2	Reach	0.39	0.39	0:03:19	0:45:33	043	060			
5	2-3	Downwind	1.08	1.08	0:10:50	0:56:23	343	000			
6	3-5	Reach	0.39	0.39	0:03:19	0:59:42	283	300			
7	5-Finish	Upwind Finish	0.30	0.42	0:05:18	1:05:00	163	180			
Totals (nm)			4.94	5.84	1:05:00						

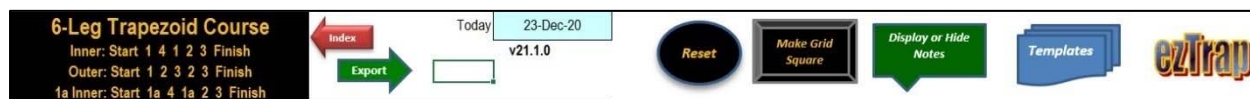
Outer				Course Information		Length (nm)		Est. Sail Time		Headings	
Leg	Marks	POS	Leg	Dist. Sailed	Leg	Cum.	°T	°M			
1	Start-1	Upwind	0.96	1.34	0:16:03	0:16:03	163	180			
2	1-2	Reach	0.39	0.39	0:02:19	0:18:22	043	060			
3	2-3	Downwind	1.08	1.08	0:08:07	0:26:29	343	000			
4	3-2	Upwind	1.08	1.51	0:18:04	0:44:33	163	180			
5	2-3	Downwind	1.08	1.08	0:08:07	0:52:40	343	000			
6	3-5	Reach	0.39	0.39	0:02:19	0:54:59	283	300			
7	5-Finish	Upwind Finish	0.30	0.42	0:05:00	0:59:59	163	180			
Totals (nm)			5.28	6.20	0:59:59						

Distance Sailed - Inner				
POS	nm	%nm	Time	%Time
Beat	3.07	53%	0:38:25	59%
Run	1.99	34%	0:19:57	31%
Reach	0.77	13%	0:06:38	10%
Total	5.84	100%	1:05:00	100%

Distance Sailed - Outer				
POS	nm	%nm	Time	%Time
Beat	3.26	53%	0:39:07	65%
Run	2.17	35%	0:16:14	27%
Reach	0.77	12%	0:04:38	8%
Total	6.20	100%	0:59:59	100%

3.10 Header Information

Each course header is unique but contains the same basic information including the sequence of the course type selected. The following header is from the **Trap6** Course:



3.10.1 Name and Sequence of Courses

The left side of the header contains a descriptive name of the course and the sequence. Where multiple variations of the course are supported, the header information will change to match the Course Type selected in the Input Values.

3.10.2 Index Arrow

Clicking the red 'index' arrow will cause ezTrap to move to the first tab in the workbook, which is the Index or Menu of all Courses, shown below.

3.10.3 Export Arrow

Clicking the green 'Export' arrow will cause ezTrap to generate a separate MS Excel® Workbook containing the current Course Display with values only (e.g., no formulae or linkages) and a picture of the Course Plot.

3.10.4 Key Dates and EXPIRED Message

Today's date is shown. Some previous versions of ezTrap have expiry dates and display the message **EXPIRED** when expired. If **EXPIRED**, the spreadsheet will continue to work; however, the wind direction will be fixed at 000° T. Upgrading to the current version is recommended to avoid this problem.

3.10.5 Version Number

The ezTrap version number is displayed for reference purposes only. Details about the version should be available on the website. The version number (e.g., V21.1.2) is typically displayed as 3-numbers separated by a period/dot. The first number (e.g., V21) refers to an ezTrap major release. The second indicates a functional addition or change, and the third relates to bug fixes or minor changes. A letter and/or the word 'Beta' may follow the version number, which indicates the release is being tested and not officially released.

3.10.6 Reset, Make Grid Square, Display or Hide Notes and Templates Buttons

The **Reset** and **Make Grid Square** buttons are explained later in the Course Plot section.

The **Display or Hide Notes** button will toggle the display of Notes related to the current course. If the course notes tab is displayed, clicking the **Display or Hide Notes** button will hide the notes. If it is hidden, the notes tab will appear, and the display will switch to the course notes.

The **Templates** button activates the generation of three Trap6 racecourse templates in a separate MS Excel® workbook.

3.10.7 Logo

The ezTrap logo appears on every page with a hyperlink to <https://www.sailwave.com/>

3.11 Input Values

The only information the user needs to enter is contained in the Input Values box – specifically the parameters that are highlighted. Excel® programming skills are not required, and the results are



instantaneous. Any of the parameters may be changed to instantly see the effects. The Input parameters and results may be saved for future reference.

All ezTrap Course Families have some common Input Values (**Trapezoid** shown below), which are described in the following sections.

INPUT VALUES				Course Plot Orientation-> <u>Wind</u>	
Mag. Wind Direction	180	°M → °T	163	Course Type Trapezoid	
<u>Area Variation</u>	17.0	W		Marks 1&4 Align.	MidPt
				Mark 1 Included Angle	60 °
	Degrees Minutes (decimal)				
RC Latitude	44	38.000	N		
RC Longitude	63	58.000	W		
	Inner		Outer		
Max. Fleet Size	30	Boats	40	M4 Offset	100.00 Metres
Avg. Boat LOA	14.0	Feet	14.0	Finish Leg Dist.	0.25 nm
Avg. Speed-Beat	4.8	Kt	5.0	Outer/Inner Spacing	110%
Avg. Speed-Run	6.0	Kt	8.0	Reach/1st Leg Ratio	44%
Avg. Speed-Reach	7.0	Kt	10.0		
Avg. Tack Angle	90	Deg.	88	Start-Line Len. Factor	110%
Target Race Time	65	Min.	60	Calc. Start-Line Length	620 Feet
				Calc. Fin.-Line Len.(25%)	160 Feet

3.11.1 Magnetic Wind Direction (000-359 °M)

This value is entered as a positive whole number between 000-359 degrees-magnetic (°M) by the user based on the current reading of the wind direction from a magnetic compass. Decimal numbers or numbers outside this range are rejected. The wind direction is immediately converted to degrees-true (°T) by using the Area Variation, discussed in the next section.

***Note:** A ship's magnetic compass can also be affected (Deviation) by onboard metals and other factors that are not considered by ezTrap. Ship's compass readings should be corrected (e.g., Compass Deviation Card) to Magnetic before using. A hand-held magnetic compass can generally be relied upon for Magnetic readings without adjustment for Deviation.*

3.11.2 Variation (0-60 Degrees, E-Easterly or W-Westerly)

The local area Variation is entered as a positive whole or decimal number along with the Easterly (E) or Westerly (W) Variation attribute.

Variation (magnetic declination) is the difference between magnetic and true North, which is measured in degrees East or West for a given local area. Variation is then used to convert back and forth between magnetic (°M) and true directions (°T) using a simple formula (i.e., $°T + °V = °M$, if °V is Westerly, or $°T - °V = °M$, if °V is Easterly).

***Note:** Although °V can be entered with partial (decimal) degrees, the °T & °M values displayed by ezTrap are expressed as whole numbers between 000-359.*

ezTrap utilizes °T for many of its internal calculations including Latitudes & Longitudes and displays °M for Course and Mark Information.



Area Variation can usually be found on a local chart inside a Compass Rose; however, it often must be adjusted if the chart is older than a few years. If you have access to the internet, you can click on the words [Area Variation](#) here or on the spreadsheet to hyperlink to a NOAA website that will provide a good approximation of the Variation in your local area. Please note that ezTrap does not capture the resulting Variation from the website – the user must enter the value in decimal degrees (no minutes or seconds) and the Easterly (E) or Westerly (W) attribute.

3.11.3 RC Boat Latitude & Longitude

The latitude and longitude of the Race Committee-Signals boat is considered the point of origin for the ezTrap calculations. These numbers are entered separately as degrees in whole numbers, decimal minutes, and the letter indicating N or S Latitude, E or W Longitude.

Note: Latitude & Longitude are sometimes expressed as degrees, minutes, and seconds; however, ezTrap and most GPS units use decimal minutes – for example 39° 30" is entered as 39.5°.

ezTrap has been validated for all navigable areas in the world including proper calculation of Latitudes and Longitudes that cross over N/S and/or E/W boundaries.

The internal calculations of Latitude & Longitude numbers utilize at least 10-decimal places of precision; however, the display values are rounded to 3-decimal places.

3.11.4 Fleet Input Values

Information about the fleet that is racing is used by ezTrap to properly size the course. The Trapezoid, Trap6, and RSXtrap courses can support two different fleets concurrently, and have provision for separate Input Values. Trap6 can support three unrelated fleets. The common parameters are described below:

- **Max. Fleet Size (2-100 boats):** The maximum number of boats in the Fleet is entered. The values are used with the LOAs in the calculation of the length of the Start and Finish Lines.
- **Avg. Boat LOA (2.5-140):** The average boat length overall (LOA) for each Fleet is entered in Feet or Metres. The values are used along with the Fleet Size for the calculation of the length of the Start and Finish Lines.
- **Avg. Boat Speeds (1-45 kt):** Average boat speeds for Close-Hauled (Beat), Reach, and Run points-of-sail (POS) in knots are used to calculate the Estimated Sailing Times by leg, which in turn is used to scale the final course up/down in conjunction with the Target Race Time. The individual speeds can be used by the RO to fine tune the course especially with planing boats and windsurfers where there may be a significant difference in speeds on different points-of-sail for the same wind speed.
- **Avg. Tack Angle (60-130°):** The Average Tack Angle in degrees refers to twice the relative angle to the wind when the boat is at speed on a close-hauled point-of-sail (POS). Further, the angle should be increased to take Leeway into account. This angle is used to calculate the Distance Sailed on upwind legs, and for the Trapezoid, Trap6, RSXtrap and Opti courses, to compute the 3-tack boxes used for spacing the Inner/Outer Courses.
- **Target Race Time (20-600 minutes):** The Target Race Time is the expected sailing time for the first racer to complete the course and is used to adjust the overall size of the course.

Note: The angle a boat turns through when tacking is typically larger because the boat speed slows and the apparent wind direction shifts aft during the turn. As the boat regains speed, the apparent wind direction shifts forward allowing the boat to point higher.



For courses with two W/L legs and two fleets, ezTrap will optimize the length of the W/L legs to meet the Target Race Times of each fleet.

3.11.5 Course Type

The Course Type Input Value allows the selection of a variation of the course. Some courses support multiple pre-programmed variations whereas others only support one type. Alternative courses are described in the Header and Course Notes.

3.11.6 Alignment of Marks with Start Line (Pin or MidPt)

All courses and variations except for the **Club Course** have a choice of Pin or Mid-point alignment:

- **Pin:** Alignment of first upwind mark (e.g., Mark 1) with the Starting-Line Pin. Can be used to bias the start towards the Pin end of the line.
- **Mid-Pt:** Alignment of first upwind mark with the mid-point of the Starting-Line.

Other marks that are aligned with the upwind Mark 1 (e.g., Mark 4 on the **Trapezoid** course) are also adjusted with this parameter.

3.11.7 Turning Mark Offset from Start Line (0-6,076)

The distance in Feet, Metres, or NM upwind of the Start Line for a turning mark (e.g., Mark 4 on the **Trapezoid** course) is entered as a whole or decimal number between 0 and 6,076. Typically, it is about 0.05 NM or more to allow room for the Fleet to round the mark, but close enough for the RC-Signals Boat to observe the rounding's.

Note: By setting the turning mark offset windward of the Start Line Distance to zero, and using the Pin alignment option, the turning mark effectively becomes the Start Line Pin.

Very large offset distances without corresponding long Target Race Times can result in unreasonably short windward/leeward legs from otherwise valid Input Values. ezTrap will provide a Warning message for very small (or negative) W/L legs for some courses.

ROs often use Gates at some marks, especially for larger fleets. ezTrap assumes that the RO and Mark Boats can set and manage these Gates without additional information.

3.11.8 Included Angle at Mark 1 (45-90°)

The Included Angle at Mark 1 is variable for most courses, fixed for the **Opti**, and **Lipton** Challenge Cup courses, and not applicable for the **W/L** courses. The value is entered as a whole number between 45 and 90 degrees. For example, an Included Angle at Mark 1 of 45° results in a relative heading that is 135° off the wind, or a Broad Reach POS. However, with faster boats, the apparent wind angle is much less, and typically ROs set the Included Angle to 45-50° for Keelboats, 55-60° for planing hulls, and 60-70° for catamarans and windsurfers.

3.11.9 Start-Line Length Factor (100-150%)

The Start-Line Length in Feet or Metres is calculated by ezTrap using the product of Maximum Fleet Size times the Average Boat LOA. This number is then adjusted by the Start-Line Length Factor, rounded up to the nearest 10 units, and shown on the display utilizing the same units as the Average Boat LOA. For example, using 14' each for a fleet of 25 Lasers and a 110% factor will yield a Start-Line Length of 390'.

The Finish-Line Length is calculated at 25% of the Start-Line Length and rounded up to the nearest 10 units of length.



3.11.10 Additional Input Values

Additional Input Values are used for some courses and are described in the detailed sections of the manual.

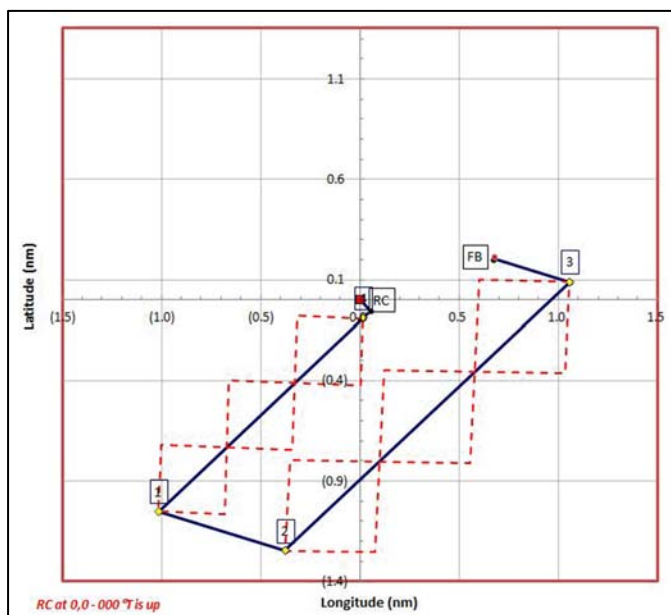
3.12 Course Plot

All ezTrap courses have a graphical course plot. A sample **Trap6** plot is shown, and other sample plots are shown in the detailed sections of the manual.

Each time the Input Values are changed, the resultant Course Plot and information are updated.

The Course Plot utilizes a Cartesian System (x-y plot) with the RC at the origin (x=0, y=0). Horizontal x-axis (Longitude) and vertical y-axis (Latitude) dimensions are shown in $\pm$ NM from the origin.

The orientation of the Plot is North (000 °T) as up. Actual Latitude & Longitude numbers are shown in the Mark Information box discussed later.



3.12.1 Course Plot Orientation

Course Plot Orientation->	<u>Wind</u>
Trapezoid	
MidPt	
60	°

North


orients the course as it would appear on a chart.

All courses have a Course Plot Orientation parameter with a choice of Wind or North (up). The choice of 'Wind' results in a wind-up view of the course with the arrow in the box pointing towards North. The North-up display

3.12.2 Plot: Course and Marks

The Course line is drawn in a solid dark color with Marks shown as small diamonds with a yellow center. The Mark Numbers are shown in a small box near each Mark. The RC-Signals Boat is shown as a small square with a red center, located at 0,0 on the plot, and labeled with 'RC' in a small box to the right. The Finish Boat is shown as a smaller red dot and labeled with 'FB'.

Note: Wherever possible ezTrap assumes the Finish Boat is downwind or to the right (looking windward) of the Finish Pin to make the sail numbers more visible to the Scorers at the Finish.

3.12.3 Plot: 3-Tack Boxes

ezTrap also plots upwind tacking boxes for the **Trapezoid**, **Trap6**, **RSXtrap**, and **Opti** courses as dashed red lines that illustrate the required clearance inside and outside the Inner and Outer courses. The 3-tack boxes are proportioned according to the respective Tack Angles of each Fleet and length of the leg. The working assumption is that racers will rarely sail an upwind leg with less than 3-tacks therefore defining a practical limit for the spacing of two fleets. Mathematically, boats with the same Tack Angle will have the same Distance Sailed upwind regardless of the number of tacks or boat speed.



3.13 Reset and Make Grid Square Buttons

Excel® uses best-fit auto-scaling for the Course Plot and does not have an automatic method of making the plot square; however, by clicking the Make Grid Square button, an ezTrap custom Visual Basic for Applications (VBA) macro is invoked that will redraw the plot with square gridlines (i.e., the same NM distance for both the x-axis and y-axis).

These buttons do not change any Input Values or results. However, if you change any Input Values, it is a good idea to click the Reset button then click the Make Grid Square button to properly update the Plot.



3.14 Mark Information

MARK INFORMATION		From RC	To RC	Dist.		
ID	Name	BRG °M	BRG °M	nm	Latitude	Longitude
RC	RC Signals Boat	000	000	0.00	20° 39' N	105° 24' W
Pin	Pin-Start Line	286	106	0.08	20° 39.033' N	105° 24.082' W
1	Inner Weather	013	193	0.93	20° 39.872' N	105° 23.644' W
1a	1a Inner Weather	013	193	0.78	20° 39.734' N	105° 23.708' W
2	Outer Weather	344	164	0.83	20° 39.82' N	105° 24.127' W
3	Outer Leeward	234	054	0.71	20° 38.666' N	105° 24.663' W
4	Inner Leeward	336	156	0.07	20° 39.063' N	105° 24.02' W
Fin-Pin	Finish Pin	221	041	0.43	20° 38.71' N	105° 24.346' W
Fin-Boat	Finish Boat	218	038	0.45	20° 38.689' N	105° 24.343' W

Mark Information (Trap6 shown above) is calculated and updated with any change of an Input Value.

3.14.1 RC Bearings and Distances to Marks

The relative Bearings in °M are shown from the RC-Signals Boat to the Marks paired with reciprocal BRGs and Distances in NM. This information and the Course Information are useful for setting and checking the proper placement of the Marks in case the Mark Boats do not have GPS, or misunderstand the Latitude and Longitude of the Mark, or the Mark is drifting off position.

3.14.2 Latitudes & Longitudes of Marks

The instantaneous calculation of precise Latitudes & Longitudes of all Marks is a key feature of ezTrap. Manual calculations or using a chart plotter will take many minutes at best and are subject to data entry and other user errors. With Latitudes & Longitudes in hand, and the general

*"If you don't know where you're going,
then you'll end up somewhere else!"*
- Yogi Berra

availability of GPS for the Race Committee-Signals (RC) and support boats, the task of setting and managing proper Marks becomes significantly faster and easier.

As mentioned earlier, the precision of internal calculations is high – 15-significant digits; however, the display of Latitudes & Longitudes is set to 3-decimal places, which is 0.001' or less than 10-Feet. The displayed precision of the results can be easily increased; however, the practical limitations of accurately setting and managing a racecourse do not appear to require the increased precision.

Note: ezTrap does not have separate Input Values for the Set and Drift of currents affecting the course. The RO is limited to changes in the Wind Direction to counteract the effects of currents.



3.15 Course Information

Tri-4 Course Information			Length (nm)		Est. Sail Time		Headings	
Leg	Marks	POS	Leg	Dist. Sailed	Leg	Cum.	°T	°M
1	Start-1	Upwind	1.15	1.51	0:15:05	0:15:05	076	100
2	1-2	Stbd-Broad Reach	1.05	1.05	0:04:13	0:19:18	316	340
3	2-3	Port-Broad Reach	1.05	1.05	0:04:13	0:23:31	196	220
4	3-1	Upwind	1.05	1.38	0:13:46	0:37:17	076	100
5	1-3	Downwind	1.05	1.05	0:06:20	0:43:37	256	280
6	3-Finish	Upwind Finish	1.25	1.64	0:16:23	1:00:00	076	100
Totals			6.63	7.69	1:00:00			

POS Stats	nm	%	Time	%Time
Beat	4.52	59%	0:45:14	75%
Run	1.05	14%	0:06:20	11%
Reach	2.11	27%	0:08:26	14%
Total	7.69	100.0%	1:00:00	100%

ezTrap provides a display of Course Information for each leg including the marks involved, point-of-sail, straight line and Distance Sailed lengths in NM, Estimated Sailing Time and Cumulative Time by Leg, and Headings in both degrees magnetic and true.

3.15.1 Headings

The Headings (°T and °M) are the actual headings for each leg, as computed from the Wind Direction, Variation, and other course information, but are not necessarily the HDGs the racers will utilize.

3.15.2 Course Lengths (NM)

ezTrap computes the length of individual legs, distance sailed, and total course length based on the Input Values, especially Tack Angle, Target Race Times, and Average Speeds for Close-hauled, Reach, and Run points-of-sail.

Note: ezTrap users have a great deal of control over the final geometry of the course and will quickly see the effects of changing the Input Values.

If a course needs adjustment, the RO should monitor the actual vs. estimated sailing times by leg then adjust the Tack Angle and/or Average Speeds accordingly. Then, by changing these Input Values, the subsequent course should better meet the Target Race Time.

Since, Trapezoid, Trap6, and RSXtrap courses are shared by two Fleets with potentially different characteristics, the adjusted lengths of the windward/leeward legs are calculated to meet the respective Target Race Times using the mathematical technique of solving two simultaneous equations with two unknowns.

3.15.3 Point-of-Sail Statistics

ezTrap provides a summary of the percent of Total Distance Sailed by point-of-sail (POS), including Beat (i.e., Close-hauled), Reach, and Run. Since many different Input Values change the geometry and size of the course, the RO may find these statistics useful in optimizing the course.

3.15.4 More on Distance Sailed

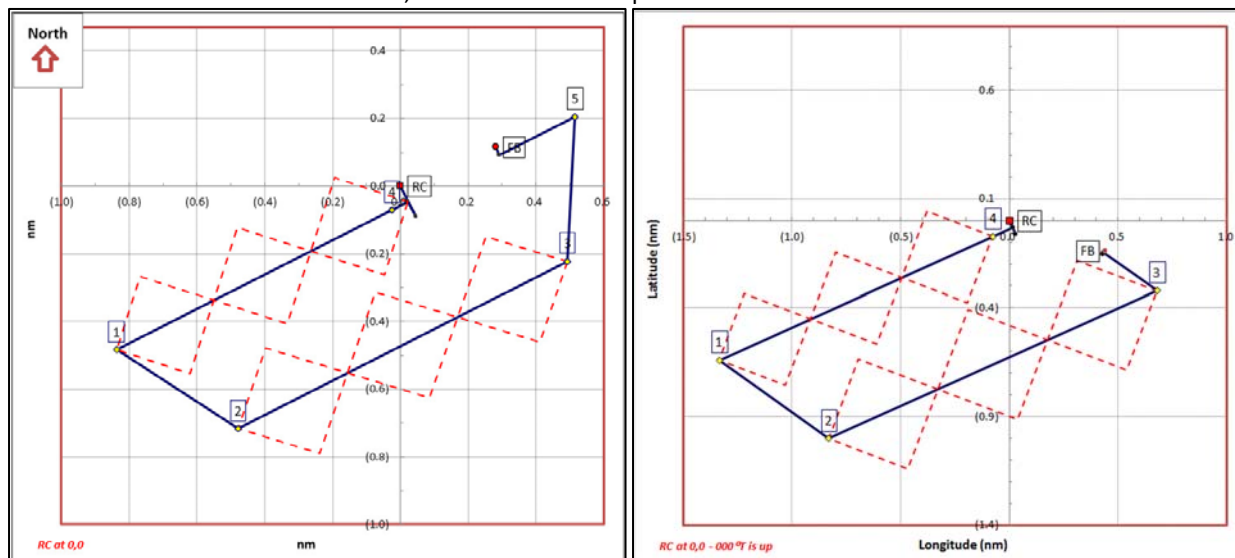
For a given Average Tack Angle (i.e., twice the Close-Hauled angle), the Distance Sailed on the windward leg is mathematically the same regardless of the number of tacks or boat speed. For example, 90° yields a ratio of 1.414 (i.e., square root of 2) times the linear length of the windward leg. As the Average Tack Angle gets smaller (i.e., sailing closer to the wind), the Distance Sailed gets smaller and vice versa.

In practice, the Distance Sailed can vary with the skill of the racer, individual boat tack angles, leeway, and the presence of a current. And, because of the inefficiencies with each tack, the Distance Sailed will increase in proportion to the number of tacks on the leg. However, with a one-design fleet the Average Tack Angle may not be as important as Average Boat Speed in adjusting the course geometry and size to meet a Target Race Time.



4. Trapezoid Courses (*Trapezoid and Trap6*)

The Trapezoid family of ezTrap has four courses with the tab names: **Trapezoid**, **Trap-6**, **Opti**, and **RSXtrap**. The first two are discussed in this section, and the others in separate sections later.



The **Trapezoid** course has 7-legs and 5-marks and is intended to be compliant with the World Sailing Olympic Trapezoid Course. Although it is possible to finish at the start-line, some ROs prefer a separate Finish Boat and Mark downwind of the Start-Line. The sequences of the **Trapezoid** courses are:

- Inner: Start-1-4-1-2-3-5-Finish
- Outer: Start-1-2-3-2-3-5-Finish

The **Trap6** course is usually considered to be the flagship trapezoid course and has 6-legs, 4-marks, and a separate Finish Boat. The finish leg is adjustable, in both angle and length to allow the RO to keep the finishing fleet from interfering with a starting fleet. The sequences of the **Trap6** courses are:

- Inner: Start-1-4-1-2-3-Finish
- Outer: Start-1-2-3-2-3-Finish

4.1 Trapezoid Input Values

The common ezTrap Input Values are described in the Getting Started section of the manual.

This section describes the Input Values that are unique to the 7-leg **Trapezoid** course.

INPUT VALUES				Course Plot Orientation-> Wind																									
Mag. Wind Direction	245	°M → °T	226	Course Type Trapezoid																									
Area Variation	18.8	W		Marks 1&4 Align.	MidPt																								
				Mark 1 Included Angle	60 °																								
	<table border="1"> <thead> <tr> <th>Degrees</th> <th>Minutes (decimal)</th> <th></th> </tr> </thead> <tbody> <tr> <td>RC Latitude</td> <td>44</td> <td>38.000 N</td> </tr> <tr> <td>RC Longitude</td> <td>63</td> <td>58.000 W</td> </tr> </tbody> </table>					Degrees	Minutes (decimal)		RC Latitude	44	38.000 N	RC Longitude	63	58.000 W															
Degrees	Minutes (decimal)																												
RC Latitude	44	38.000 N																											
RC Longitude	63	58.000 W																											
	<table border="1"> <thead> <tr> <th></th> <th>Inner</th> <th>Outer</th> </tr> </thead> <tbody> <tr> <td>Max. Fleet Size</td> <td>30</td> <td>Boats 40</td> </tr> <tr> <td>Avg. Boat LOA</td> <td>14.0</td> <td>Feet 14.0</td> </tr> <tr> <td>Avg. Speed-Beat</td> <td>4.8</td> <td>Kt 5.0</td> </tr> <tr> <td>Avg. Speed-Run</td> <td>6.0</td> <td>Kt 8.0</td> </tr> <tr> <td>Avg. Speed-Reach</td> <td>7.0</td> <td>Kt 10.0</td> </tr> <tr> <td>Avg. Tack Angle</td> <td>90</td> <td>Deg. 88</td> </tr> <tr> <td>Target Race Time</td> <td>65</td> <td>Min. 60</td> </tr> </tbody> </table>						Inner	Outer	Max. Fleet Size	30	Boats 40	Avg. Boat LOA	14.0	Feet 14.0	Avg. Speed-Beat	4.8	Kt 5.0	Avg. Speed-Run	6.0	Kt 8.0	Avg. Speed-Reach	7.0	Kt 10.0	Avg. Tack Angle	90	Deg. 88	Target Race Time	65	Min. 60
	Inner	Outer																											
Max. Fleet Size	30	Boats 40																											
Avg. Boat LOA	14.0	Feet 14.0																											
Avg. Speed-Beat	4.8	Kt 5.0																											
Avg. Speed-Run	6.0	Kt 8.0																											
Avg. Speed-Reach	7.0	Kt 10.0																											
Avg. Tack Angle	90	Deg. 88																											
Target Race Time	65	Min. 60																											
				M4 Offset	0.05 nm																								
				Finish Leg Dist.	0.25 nm																								
				Outer/Inner Spacing	110%																								
				Reach/1st Leg Ratio	44%																								
				Start-Line Len. Factor	110%																								
				Calc. Start-Line Length	620 Feet																								
				Calc. Fin.-Line Len.(25%)	160 Feet																								

4.1.1 Course Plot Orientation – Wind Direction or North

A feature of all courses is the option to have the course plot oriented with the Wind Direction up or North-up. There is no effect on the calculated results other than the orientation of the Course Plot.

4.1.2 Finish Leg Distance (0.05-6,076)

The Finish Leg Distance in Feet, Metres or NM between Mark 5 and the Finish Line is entered as a whole or decimal number between 0.05 and 6,076. The final leg is not scaled up/down with the other factors, and the RO can control the location of the finish area with this parameter. If the RO wishes to set the Finish Line on the Start Line, the parameter can be easily varied until the Course Plot shows the desired length.

4.1.3 Outer/Inner Spacing Factor (50-250%)

ezTrap utilizes the premise that the Reach between the Inner/Outer Course is not as tactical as the windward/leeward legs and minimizes the separation of the two courses without intentionally causing upwind tacking interference between the two Fleets.

3-Tacks are assumed when calculating the potential interference between Fleets. The spacing is then determined by the length of the windward/leeward legs, and the Tack Angles of the two Fleets. The calculated spacing may be adjusted with the Outer/Inner Spacing Factor as needed.

A 100% value will result in the 3-tack boxes just touching - less than 100% may result in some interference - and greater than 100% will create more space between the Fleets. Some interference may still occur with boats that sail the windward legs in 1-2 tacks, or that sail past the lay line.

As the windward/leeward legs get longer (e.g., changes in Target Race Times), the spacing between the two Fleets gets wider.

4.1.4 Ratio of Reach to 1st Leg Length (Calculated %)

Some ROs prefer the length of the Reach be a certain ratio to the length of the first leg (e.g., 2/3 or 66%). This Ratio is calculated and displayed by ezTrap enabling the RO to make optional adjustments to the Outer/Inner Spacing Factor until the desired ratio is achieved.



4.2 Trap6 Input Values

The common ezTrap Input Values are described in the Getting Started section of the manual. This section describes the Input Values that are unique to the 6-leg **Trap6** course.

The only differences between the **Trapezoid** and **Trap6** courses are the addition of the 'Finish Leg Angle' and '1a Offset' Input Values.

4.2.1 Finish Leg Angle (45-135°) - Trap6 Only

Both Fleets finish the **Trap6** course with a Gybe around

Mark 3 to the Finish Line. The Finish Turn Angle is the turning angle to Port from the downwind run to the finish leg and is entered as a whole number between 45 and 135 degrees.

4.2.2 Finish Leg Distance (0.05-6,076)

For **Trap6**, Finish Leg Distance in Feet, Metres or NM between Mark 3 and the Finish Line is entered as a whole or decimal number between 0.05 and 6,076. The final leg is not scaled up/down with the other factors, and the RO can control the location of the finish area with this parameter and the Finish Leg Angle.

4.2.3 Outer/Inner Spacing Factor (50-250%)

ezTrap utilizes the premise that the Reach between the Inner/Outer Course is not as tactical as the windward/leeward legs and minimizes the separation of the two courses without intentionally causing upwind tacking interference between the two Fleets.

3-Tacks are assumed when calculating the potential interference between Fleets. The spacing is then determined by the length of the windward/leeward legs, and the Tack Angles of the two Fleets. The calculated spacing may be adjusted with the Outer/Inner Spacing Factor as needed.

A 100% value will result in the 3-tack boxes just touching - less than 100% may result in some interference - and greater than 100% will create more space between the Fleets. Some interference may still occur with boats that sail the windward legs in 1-2 tacks, or that sail past the lay line.

As the windward/leeward legs get longer (e.g., changes in Target Race Times), the spacing between the two Fleets gets wider.

4.2.4 Ratio of Reach to 1st Leg Length (Calculated %)

Some ROs prefer the length of the Reach to be a certain ratio to the length of the first leg (e.g., 2/3 or 66%). This Ratio is calculated and displayed by ezTrap enabling the RO to make optional adjustments to the Outer/Inner Spacing Factor until the desired ratio is achieved.

6-Leg Trapezoid Course				Today 23-Dec-20	
Inner: Start 1 4 1 2 3 Finish				v21.1.0	
Outer: Start 1 2 3 2 3 Finish					
1a Inner: Start 1a 4 1a 2 3 Finish					
Index Export					
INPUT VALUES					
Mag. Wind Direction	010	°M → °T	350	Course Type	Trap6
Area Variation	20.0	W		Marks 1&4 Align	MidPt
Degrees Minutes (decimal)				Mark 1 Included Angle	60 °
RC Latitude	44	38.000	N	Finish Leg Angle	120 °
RC Longitude	63	58.000	W	M4 Offset	0.05 nm
				1a Offset	(0.15) nm
				Calc. Mark 1a Included Angle	76 °
Inner Outer 1a Inner				Finish Leg Length	0.40 nm
Max. Fleet Size	50	50	10	Outer/Inner Spacing	110%
Avg. Boat LOA	14.0	14.0	14.0	Reach/1st Leg Ratio	67%
Avg. Speed-Beat	4.8	5.0	4.0	Start-Line Len. Factor	120%
Avg. Speed-Run	6.0	8.0	5.0		
Avg. Speed-Reach	7.0	10.0	6.0		
Avg. Tack Angle	90	88	92	Calc. Start-Line Length	850 Feet
Target Race Time	60	75	44	Calc. Fin.-Line Len.	220 Feet

NM	Metres	Feet
1.00	1,852	6,076
0.02	30	100
0.08	152	500
0.16	305	1,000
0.03	50	164
0.05	100	328
0.08	150	492
0.05	93	304
0.10	185	608
0.15	278	911



4.2.5 Mark 1a Offset (Trap6)

Trap6 will optionally support a third fleet with the use of an optional 1a Mark above or below Mark 1. The offset distance can be entered as a $\pm$ 0-6,076 decimal number for Feet, Metres, or NM. Typically, the 1a Mark is set below Mark 1, which requires a negative value such as -.10 NM. When set to zero, Marks 1a and 1 are effectively the same.

Separate Input Values and Course Information Display are provided for the third fleet that uses the 1a Option. The Average Speeds and Tack Angle are used to calculate the Estimated Sailing and Cumulate Time by Leg; however, the number of Boats, Average LOA, and Target Race Time Input Values are for reference only and are not used for any calculations.

4.3 TRAP6 Templates (Simple Excel® Worksheets with Marks & Course Information)

A new feature with ezTrap V21 is the automatic generation of TRAP6 Templates. When comfortable that the Input Values are stable, the end user clicks on the 'Templates' icon to activate the process. The end user is asked to enter three different sets of Inner and Outer Target Race Times (TRTs). ezTrap then produces a Trap6 Template one-page worksheet as a separate file in a few seconds. A sample printout of the top-half of a Template is shown below.



v21.1

#1

TRTs

30

45

Template Wind = 000

Actual Wind

090

Leg	Marks	Inner-Outer Leg (nm)		Relative BRG (°M)		Mark	RC Dist. To Mark (nm)	Actual BRG (°M)	
				From RC	To RC			From RC	To RC
1	Start-1	0.31	0.31						
2	1-4	0.26	0.30	352	172	1	0.32	082	262
3	4-1	0.26	1.12	346	166	1a	0.17	076	256
4	1-2	0.30	1.12	299	119	2	0.34	029	209
5	2-3	1.12	1.12	197	017	3	1.00	287	107
6	3-Finish	0.40	0.40	320	140	4	0.07	050	230
Total Length		2.66	4.38	177	357	FinPin	0.75	267	087

#2

TRTs

45

60

Template Wind = 000

Actual Wind

Leg	Marks	Inner-Outer Leg (nm)		Relative BRG (°M)		Mark	RC Dist. To Mark (nm)	Actual BRG (°M)	
				From RC	To RC			From RC	To RC
1	Start-1	0.55	0.55						
2	1-4	0.50	0.41	356	176	1	0.55		
3	4-1	0.50	1.45	354	174	1a	0.40		
4	1-2	0.41	1.45	311	131	2	0.53		
5	2-3	1.45	1.45	200	020	3	1.18		
6	3-Finish	0.40	0.40	320	140	4	0.07		
Total Length		3.81	5.71	184	004	FinPin	0.90		

The Template will show the Input Values provided by the RO and the ezTrap calculated results for the three sets of TRTs. The Wind Direction defaults to 000, and the relative bearings (BRG) and distances (NM) to the Marks are calculated along with the lengths (NM) of each of the legs.

The Trap6 Template is created as a separate Excel® (.xlsx) worksheet with space for the RO to enter the Real Wind Direction to calculate the Real BRGs of the Marks to/from the RC Signals Boat.

The spreadsheet can be printed (e.g., PDF) in advance of the race and then used by the RO to manually calculate the Real BRGs. As a simple Excel® spreadsheet, it can also be loaded or transmitted to a computer or Smartphone that supports simple Excel® worksheets and then used to automatically calculate Real BRGs (see #1 template below).



Latitudes & Longitudes of the Marks, and more details about the course are not provided. Although three sets of TRTs are supported, only one set of the Input Values is used for the calculations. So, the RO should be confident that the values are consistent with the expected fleet(s) performance and wind conditions.

No changes are made to the ezTrap app because of the creation of the Template. Each template workbook is given a unique date/time stamp in the filename, and there is no practical limit to the number of times the TRAP6 Template function can be used.

The bottom half of the sample Template is shown below:

#3	TRTs	60	90	Template Wind = 000				Actual Wind	
Leg	Marks	Inner-Outer Leg (nm)		Relative BRG (°M)		Mark	RC Dist. To Mark (nm)	Actual BRG (°M)	
				From RC	To RC			From RC	To RC
1	Start-1	0.65	0.65	356	176	1	0.66		
2	1-4	0.60	0.61	355	175	1a	0.51		
3	4-1	0.60	2.30	302	122	2	0.67		
4	1-2	0.61	2.30	196	016	3	2.04		
5	2-3	2.30	2.30	320	140	4	0.07		
6	3-Finish	0.40	0.40	187	007	FinPin	1.76		
Total Length		5.18	8.58						

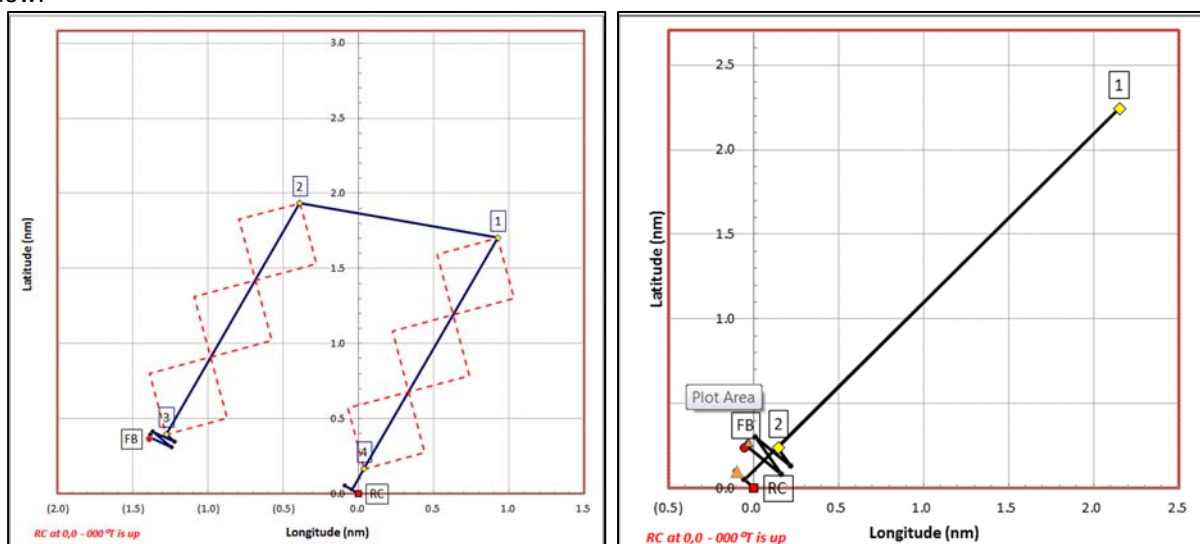
TRAP6 INPUT VALUES FOR TEMPLATES									
				Course Type		Trap6			
				Marks 1&4 Align.		MidPt			
				Mark 1 Included Angle		60.0	°		
				Finish Leg Angle		120.0	°		
				M4 Offset		0.05	nm		
				1a Offset		(0.15)	nm		
				Calc. Mark 1a Included Angle		81	°		
				Finish Leg Length		0	nm		
				Outer/Inner Spacing		1.1			
				Reach/1st Leg Ratio		75%			
				Start-Line Len. Factor		1.2			
				Calc. Start-Line Length		510	Feet		
				Calc. Fin.-Line Len.(25%)		130	Feet		

Max. Fleet Size	20	30	10
Avg. Boat LOA	14.0	14.0	14.0
Avg. Speed-Beat	4.8	5.0	4.0
Avg. Speed-Run	6.0	8.0	5.0
Avg. Speed-Reach	7.0	10.0	6.0
Avg. Tack Angle	90	88	92

Boats
Feet
Kt
Kt
Kt
Deg.

5. RS:X Windsurfer Slalom Courses (RSXtrap & RSXls)

The ezTrap RS:X Windsurfer Trapezoid **RSXtrap** and Windward/Leeward Slalom **RSXls** courses are illustrated below:



The **RSXtrap** course (shown on the left) is a classic trapezoid course with a slalom finish that can support two different fleets. It has three variations including 1, 2, or 3 W/L legs. The **RSXls** course is a classical windward/leeward course with a slalom finish. It also has three variations.

The common ezTrap Input Values are described in the Getting Started section of the manual.

5.1 RSX Input Values

The unique Input Values for **RSXtrap** are like the **Trapezoid** and **Trap6** courses but with the addition of the Initial Slalom Angle and Slalom Leg Distance. These two additions are also used for the **RSXls** course.

5.1.1 Course Type

The user can select one of three variations of the RSX Courses from the drop-down list values for once, twice, and three times around the W/L legs of the course (6, 8, or 10 legs).

RS:X Trapezoid Slalom Course				Today 3-Dec-20	
Inner: Start-1-4-1-4-1-2-3-S123-Finish				v21.1	
Outer: Start-1-2-3-2-3-2-3-S123-Finish					
INPUT VALUES					
Mag. Wind Direction	351	°M → °T	000	Course Type	RSX-2
Area Variation	9.0	E		Marks 1&4 Align.	MidPt
				Mark 1 Included Angle	70°
				Initial Slalom Angle	16°
				M4 Offset	0.05 nm
				Slalom Leg Dist.	300 Metres
				Outer/Inner Spacing	115%
				Reach/1st Leg Ratio	48%
				Start-Line Len. Factor	110%
				Calc. Start-Line Length	190 Metres
				Calc. Fin.-Line Len.(25%)	50 Metres

Degrees		Minutes (decimal)	
RC Latitude	52	45.500	N
RC Longitude	5	2.000	W

	Inner	Outer
Max. Fleet Size	60	50
Avg. Boat LOA	2.9	2.9
Avg. Speed-Beat	6.0	8.0
Avg. Speed-Run	12.0	14.0
Avg. Speed-Reach	15.0	16.0
Avg. Tack Angle	92	88
Target Race Time	60	55

The Course Types and sequences of the **RSXtrap** course are:

- RSX-1
 - o Inner: Start-1-4-1-2-3-S123-Finish
 - o Outer: Start-1-2-3-2-3-S123-Finish
- RSX-2
 - o Inner: Start-1-4-1-4-1-2-3-S123-Finish
 - o Outer: Start-1-2-3-2-3-2-3-S123-Finish



- RSX-3
 - o Inner: Start-1-4-1-4-1-2-3-S123-Finish
 - o Outer: Start-1-2-3-2-3-2-3-2-3-S123-Finish

The Course Types and sequences of the **RSXIs** course are:

- LS-1 (6-legs): Start-1-2-S123-Finish
- LS-2 (8-legs): Start-1-2-1-2-S123-Finish
- LS-3 (10-legs): Start-1-2-1-2-S123-Finish

5.1.2 Initial Slalom Angle (10-30°)

This angle is used to position the first slalom mark (S1). The Initial Slalom Angle + 90° is the internal angle at M3 or the total degrees off the wind. From the windsurfer's point of view, the turn to port from the downwind run to S1 is equivalent to 90° less the Initial Slalom Angle. The typical value for the Initial Slalom Angle is 10°, which results in a Reach 100° off the wind, or a turn to port at M3 of 80°.

The subsequent turns to S2, S3, and the Finish are equal to 180° less 150% of the Initial Slalom Angle. For example, for an Initial Slalom Angle of 16° (shown above) the turns at S1, S2, and S3 would be 156° (180° less 24°).

5.1.3 Mark Offset from Start Line (0-6,076)

The distance in Feet, Metres, or NM upwind of the Start Line for a turning mark (e.g., Mark 4 on the **RSXtrap** course and M2 on the **RSXIs** course) is entered as a positive whole or decimal number between 0 - 6,076. Typically, it is about 0.05 NM or more to allow room for the Fleet to round the mark, but close enough for the RC-Signals Boat to observe the roundings.

Very large offset distances without corresponding long Target Race Times can result in unreasonably short windward/leeward legs from otherwise valid Input Values.

Further, with a 'Pin' alignment and a zero offset, the Start Line Pin effectively becomes the mark, which can be desirable when there are limited marks or mark boats.

Typically, the RSXIs M2 offset is larger to allow the slalom legs and finish to occur windward of the Start Line.

5.1.4 Slalom Leg Distance (0.05-6,076)

The Slalom Leg Distance in Feet, Metres or NM between Mark 3 and the Finish Line is entered as a whole or decimal number between 0.05 - 6,076.

The first slalom leg (M3 to S1) is calculated at 50% of the value.
The slalom legs are not scaled up/down with the other factors.

5.1.5 Outer/Inner Spacing Factor (50-250%)

ezTrap utilizes the premise that the Reach between the **RSXtrap** Inner/Outer Course is not as tactical as the windward/leeward legs and minimizes the separation of the two courses without intentionally causing upwind tacking interference between the two Fleets.

3-Tacks are assumed when calculating the potential interference between Fleets. The spacing is then determined by the length of the windward/leeward legs, and the Tack Angles of the two Fleets. The calculated spacing may be adjusted with the Outer/Inner Spacing Factor as needed.

NM	Metres	Feet
1.00	1,852	6,076
0.02	30	100
0.08	152	500
0.16	305	1,000
0.03	50	164
0.05	100	328
0.08	150	492
0.05	93	304
0.10	185	608
0.15	278	911



A 100% value will result in the 3-tack boxes just touching - less than 100% may result in some interference - and greater than 100% will create more space between the Fleets. Some interference may still occur with boats that sail the windward legs in 1-2 tacks, or that sail past the lay line.

As the windward/leeward legs get longer (e.g., changes in Target Race Times), the spacing between the two Fleets gets wider.

5.1.6 Ratio of Reach to 1st Leg Length (Calculated %)

Some ROs prefer the length of the Reach between M1 and M2 of the **RSXtrap** course to be a certain ratio to the length of the M4-M1 leg – 75% is typical. This Ratio is calculated and displayed by ezTrap enabling the RO to make optional adjustments to the Outer/Inner Spacing Factor until the desired ratio is achieved.



6. Optimist Course (Opti)

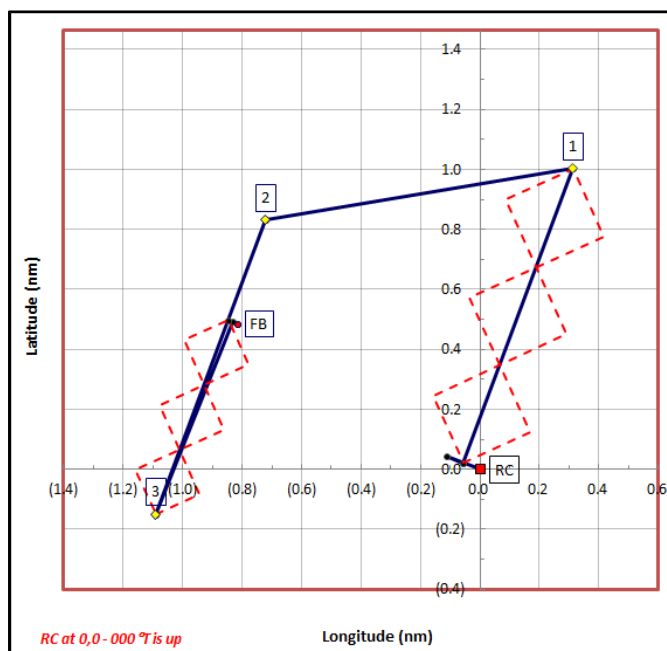
Two versions of the Optimist course are supported - International (IODA) with an upwind finish, and US (USODA) with a reach finish. Windward, Reach, and Leeward legs are all the same length. The included angle of turn at Mark 1 is fixed at 60°. Some race officers have used the **Trapezoid**, **Trap6**, and other ezTrap courses for Optimists.

The Opti Worlds Course (IODA) has 4-legs, 3-marks, and separate Start and Finish Lines. The sequence for the course is: **Start-1-2-3-Finish**.

Although the size of the course can vary with several parameters, the relative geometry is fixed using the following attributes:

- The first three legs are the same length with the Included Angle at Mark 1 = 60°;
- The third leg is parallel to the first leg;
- The length of the fourth leg (i.e., upwind finish from Mark 3 to the Finish-Line) is controlled by the RO as a percentage (50-150%) of the 3rd leg and is also parallel to the first and third legs.

Upwind Finish Leg length is set as a % of the length of Marks 2-3 leg. Note: 100% will result in Finish Pin at same locations as Mark 2. For USODA, this defines the placement of Mark 4.



6.1 Optimist Course Input Values

The common ezTrap Input Values are described in the Getting Started section of the manual. This section describes the Input Value that is unique to the **IODA** and **USODA** courses – Finish Leg Distance.

INPUT VALUES									
Mag. Wind Direction	200	°M → °T		176	Course Type	USODA			
Area Variation	24.4	W			Mark 1 Alignment	MidPt			
Degrees Minutes (decimal)									
RC Latitude	33	51.000		N	Finish M4 Dist. (% M2-3)	150%			
RC Longitude	18	24.000		W	USODA Finish Line Offset	100.0		Metres	
Max. Fleet Size	20	Boats							
Avg. Boat LOA	2.4	Metres							
Avg. Speed-Beat	4.0	Kt							
Avg. Speed-Run	4.5	Kt							
Avg. Speed-Reach	5.0	Kt							
Avg. Tack Angle	100	Deg.							
					Target Race Time	60		Min.	
					Start-Line Len. Factor	110%			
					Calc. Start-Line Length	60		Metres	
					Calc. Finish-Line Len.	20		Metres	

6.1.1 Finish Leg Distance (50-150% of third leg)

For the **IODA** and **USODA** courses, the final windward leg distance is calculated as a percentage of the length of the third leg, which is also the same distance as the first leg and the Reach. The length of the final leg is scaled up/down with the other factors, but the same proportion is maintained. Note that a value of 100% will result in the Finish-Line Pin having the same Latitude & Longitude as Mark 2. The **USODA** utilizes a separate 'Finish Line Offset' parameter to offset the finish line to allow a reach finish after rounding the finish pin.



7. Windward/Leeward Course (W/L)

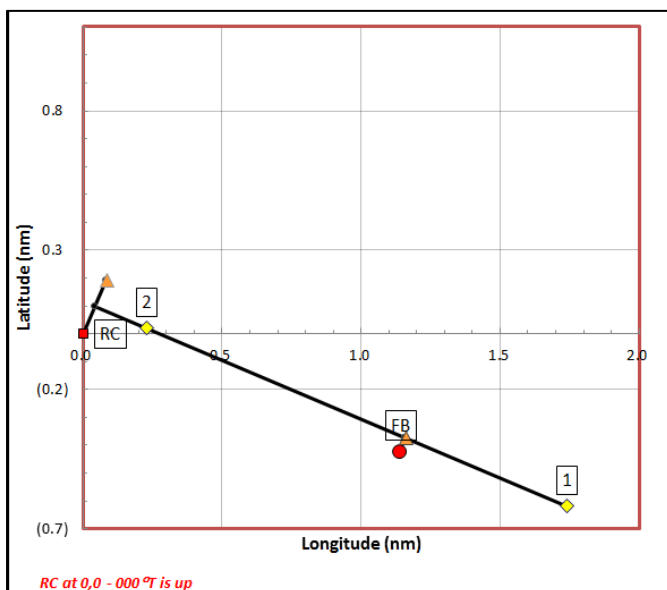
The ezTrap Windward/Leeward Course is described in this section.

The W/L course supports 5-variations, which are compliant with the World Sailing Courses, and 3-variations (WL3, WL5 and WL7) that are equivalent to the Lipton Challenge Cup "S" courses: S-1, S-2, and S-3.

7.1 Windward/Leeward Course Input Values

The common ezTrap Input Values are described in the Getting Started section of the manual.

This section describes the Input Values that are unique to the **W/L** course – Course Types, and % Finish Distances.



7.1.1 Course Types

Five variations of the Windward/Leeward Course are supported, and can be selected from a Drop-down List:

- **WL-3** is a 3-leg course with an upwind Finish. The distance of the last upwind leg is calculated as a % of the W/L leg length. This is also used to plan the Lipton Challenge Cup "S-1", once around course.
- **WL-4** is a 4-leg course with the Finish at the Start Line.
- **WL-5** is a 5-leg course with an upwind Finish. The distance of the last upwind leg is calculated as a % of the W/L leg length. This is also used to plan the Lipton Challenge Cup "S-2", twice around course.
- **WL-6** is a 6-leg course with the Finish at the Start Line.
- **WL-7** is a 7-leg course with an upwind Finish. The distance of the last upwind leg is calculated as a % of the W/L leg length. This is also used to plan the Lipton Challenge Cup "S-3", three times around course.

INPUT VALUES					
Mag. Wind Direction	090	°M → °T	113	Course Type	WL-5
Area Variation	22.9	E		Marks 1&2 Align:	MidPt
	Degrees		Minutes (decimal)	M2 Offset	0.20 nm
RC Latitude	41	16.000	S	WL3,5&7 % Fin Dist.	62% %
RC Longitude	174	49.000	E	Target Race Time	60 Min.
Max. Fleet Size	60	Boats		Start-Line Len. Factor	150%
Avg. Boat LOA	14.0	Feet		Calc. Start-Line Length	1,270 Feet
Avg. Speed-Beat	8.0	Kt		Calc. Fin.-Line Len.	320 Feet
Avg. Speed-Run	16.0	Kt			
Avg. Tack Angle	90	Deg.			

7.1.2 WL-3, WL-5 & WL-7 Finish Leg Distance (20-150% of W/L Leg)

For the **WL-3**, **WL-5** & **WL-7** courses, the final windward leg distance is extended upwind of Mark 2 based on a percentage of the W/L leg distance. For example, 100% is the equivalent of having the Finish Pin at M1. The final leg is also included in the calculation of the M2-M1 W/L Leg distance to meet the Target Race Time.

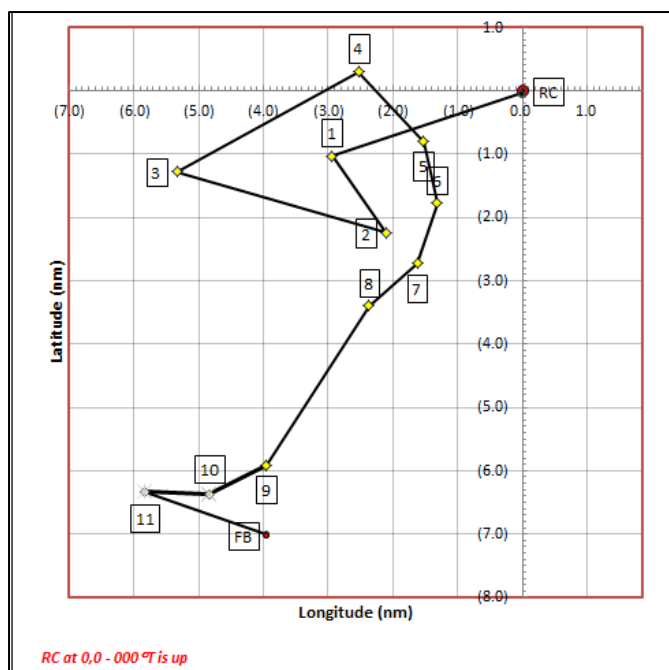


8. Yacht Club Course (Club)

The yacht **Club** Course is the do-it-yourself custom course design of the ezTrap family and can often be used to duplicate other courses or add variations.

The **Club** course allows the RO to design a custom course of up to 12 legs utilizing simple parameters of relative turns and distance. Further, the **Club Course** can make use of predefined fixed marks that are typically part of many yacht club 'round the buoys' racecourses as well as for coastal and ocean racing.

This **Club Course** plot shown is an example of a course that uses six fixed marks, and six moveable marks. It is based on the Input Values that are used in the Fixed Marks Table and Course Table examples that follow. However, a **Club Course** can be composed of any mixture of calculated or fixed marks.



8.1 Club Course Input Values

The common ezTrap Input Values are described in the Getting Started section of the manual. This section describes the Input Values that are unique to the **Club Course**.

INPUT VALUES															
Mag. Wind Direction	090	°M → °T	091												
Area Variation	0.5	E	Course Name: 11												
<table border="1"> <thead> <tr> <th></th> <th>Degrees</th> <th>Minutes (decimal)</th> <th></th> </tr> </thead> <tbody> <tr> <td>RC Latitude</td> <td>51</td> <td>45.770</td> <td>N</td> </tr> <tr> <td>RC Longitude</td> <td>-</td> <td>54.600</td> <td>E</td> </tr> </tbody> </table>					Degrees	Minutes (decimal)		RC Latitude	51	45.770	N	RC Longitude	-	54.600	E
	Degrees	Minutes (decimal)													
RC Latitude	51	45.770	N												
RC Longitude	-	54.600	E												
Max. Fleet Size	30	Boats	Start-Line Len. Factor 100%												
Avg. Boat LOA	8.0	Metres	Calc. Start-Line Length 250 Metres												
Avg. Boat Speed-Beat	6.0	Kt	Calc. Fin.-Line Len. 70 Metres												
Avg. Boat Speed-Run	5.0	Kt													
Avg. Boat Speed-Reach	7.5	Kt													
Avg. Tack Angle	70	Deg.													

8.1.1 Course Name

The **Club Course** allows the user to enter a name for the course that will show on the display and any printouts; however, the Course Name is not used for any other purpose.

8.2 Pre-defined Fixed Marks Table

With v23 ezTrap allows up to 21-fixed marks to be entered in the Fixed Marks Table. The marks must be defined in the Table to be used as Fixed Marks in designing the course. The table does not need to be complete or in any specific sequence, and the user does not have to use any or all the pre-defined marks. Further, the user can create numerous courses from the same Fixed Marks Table and save the courses with unique names to be used later.



8.2.1 Fixed Mark ID

Each entry has a unique ezTrap ID (i.e., FM1 to FM21) that is also used in designing the course. The sequence of marks in the table is not important, and entries may be empty if they are not being used.

Fixed Marks Table		Latitude		Longitude	
ID	Name	Degrees	Minutes (decimal)	Degrees	Minutes (decimal)
FM1	WMYC 1	51	45.820 N	-	56.250 E
FM2	WMYC 2	51	45.210 N	-	56.620 E
FM3	WMYC 3	51	45.130 N	-	52.900 E
FM4	WMYC 5	51	44.920 N	-	53.930 E
FM5	WMYC 6	51	45.740 N	-	58.960 E
FM6	WMYC 10	51	44.820 N	-	59.410 E
FM7	WMYC 12	51	44.450 N	-	53.000 E
FM8	WMYC 14	51	45.450 N	-	53.910 E
FM9	WMYC 17	51	45.210 N	-	55.110 E
FM10				-	57.620 E
FM11	MG	51	45.610 N	-	55.450 E
FM12	OLM (s)	51	45.580 N	-	54.750 E

8.2.2 Fixed Mark Name

Each mark entered can have an alphanumeric name that is also used in the Mark Information Display. Approximately 8-characters will be visible in the Fixed Marks Table, and 14-16 characters in the Mark Information display. No editing is performed.

8.2.3 Fixed Mark Latitude and Longitude

Latitudes and Longitudes for the Fixed Marks Table follow the same rules as when entering the RC Latitude & Longitude. If there is no entry or the N or S, or W or E are missing, then an error message **Lat Err** or **Long Err** will be displayed. If an N or S and W or E are present, but no degrees or minutes, the values are assumed to be zero. Even with the **Lat Err** message or zero values, ezTrap will continue to work; however, if the Fixed Mark is used in the course the results may be undesirable.

8.3 Yacht Club Course Table

ezTrap allows up to 12 legs in a customized **Club Course**. Each leg has a unique ID (i.e., 1 to 12) and is designated with an uppercase 'F' for Fixed Mark, or 'C' for a calculated leg. The RC-Signals Boat location is the assumed fixed starting point.

8.3.1 Calculated Legs ('C')

For a calculated leg, ezTrap takes the previous leg's ending position then calculates a new ending position using the Turn and NM parameters. Turns are changes in headings in relative degrees where turning to port is negative, and starboard positive. The initial leg (#1) is assumed to be directly up-wind unless modified by the relative heading of the Turn.

In the following example the 11th leg will produce a 90 degree turn to starboard from the initial Wind Direction, and for a length of 1.00NM.

The Mark ID column can be used optionally by the RO to name the mark (e.g., T1) at the end of the leg. If blank, the name defaults to 'CM' for calculated mark. The Mark Name is also shown in the Mark Information and Course Information display.

8.3.2 Fixed Legs ('F')

For a leg using a Fixed Mark the RO must enter (upper or lower case supported) one of the pre-defined values (FM#) from the Fixed Marks Table. The Turn and NM columns

Leg ID	F or C	Mark ID	Turn	nm	Rounding
0	F	RC	0	-	P, S or PS
1	F	FM3			P
2	F	FM8			P
3	F	FM3			P
4	F	FM11			P
5	F	FM1			P
6	F	FM12			PS
7	F	FM8			P
8	F	FM13			P
9	F	FM4			S
10	F	FM21			P
11	C	T1	90	1.00	P
12	F	FM21			



are then blacked out and are not used. The leg starts from the previous leg's position and ends at the specified Fixed Mark. ezTrap calculates the heading and distance between these two points.

No other edits or logic are applied; so if there is an error in the Fixed Marks Table the results may not be as desired. Further, unlike other ezTrap Courses, there is no provision in the **Club Course** for automatically resizing the course to meet Target Race Times.

8.3.3 Roundings

Port (**P**), Starboard (**S**), or either (**PS**) mark roundings are added to the Course Table in the last column and carried over to the Course Information display. The roundings are not used by ezTrap for any calculations.

8.3.4 Course Information

11 Course Information														
				Length (nm)		Est. Sail Time		Headings						
Leg	Mark Name	Rounding	P.O.S.	Leg	Dist. Sailed	Leg	Cum.	°T	°M	POS	nm	%nm	Time	%Time
1	WMYC 3	P	B.Reach	1.27	1.27	0:10:09	0:10:09	236	236	Close Hauled	3.53	55%	0:35:18	60%
2	WMYC	S	Beat	0.70	0.86	0:08:35	0:18:44	063	062	Close Reach	-	0%	0:00:00	0%
3	WMYC 3	P	B.Reach	0.70	0.70	0:05:37	0:24:21	243	242	Reach	-	0%	0:00:00	0%
4	MG	P	Beat	1.65	2.02	0:20:09	0:44:30	073	073	Broad Reach	2.93	45%	0:23:27	40%
5	WMYC 1	P	Beat	0.54	0.66	0:06:34	0:51:04	067	066	Run	-	0%	0:00:00	0%
6	OLM (s)	P	B.Reach	0.96	0.96	0:07:41	0:58:45	256	255					
Totals				5.82	6.46	0:58:45								

The Yacht Club Course Information display is like other ezTrap displays and includes the Name of the course given by the user ("11" above), and the calculated POS (point-of-sail) for each leg.

8.3.5 Point-of-sail Statistics

ezTrap provides a summary of the percent of Total Distance Sailed (NM) by POS, including Close-hauled, Close-reach, Reach, Broad-reach, and Run. Since many different Input Values change the geometry and size of the course, the RO may find these statistics useful in optimizing the course. ezTrap uses the following table of relative heading thresholds to determine POS statistics:

0	Close Hauled (Beat)
45	Close Reach
70	Reach
120	Broad Reach
170	Run



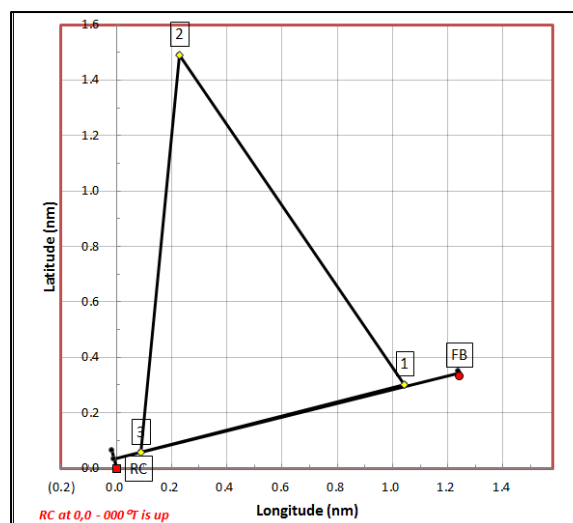
9. Triangle Course (Triangle)

The **Triangle** Course is intended to be compliant with the World Sailing Olympic Triangle Course. It contains three variations: Tri-2, Tri-3, and Tri-4 (shown).

The sequences of the three variations are:

- Tri-2: Start-1-2-Pin-1-Finish at Start
- Tri-3: Start-1-2-3-1-3-Finish at Start
- Tri-4: Start-1-2-3-1-3-Finish Upwind

Additional ezTrap triangle courses and variations are available in the Lipton Challenge Cup Family – see the descriptions of the Lipton “T” and “O” courses.



9.1 Triangle Course Input Values

The common ezTrap Input Values are described in the Getting Started section of the manual.

This section describes the Input Values that are unique to the **Triangle** course – Course Type and **Tri-4** Finish Leg Distance

9.1.1 Course Types (Tri-2, Tri-3 or Tri-4)

Three variations of the **Triangle** course are supported, and can be selected from a Drop-down List:

INPUT VALUES					
Mag. Wind Direction	100	°M → °T	076	Course Type	Tri-4
Area Variation	24.4	W		Marks 1&3 Align.	MidPt
				Mark 1 Included Angle	60 °
Degrees Minutes (decimal)					
RC Latitude	33	51.000	S	Tri-3&4 M3 Offset	0.10 nm
RC Longitude	18	24.000	E	Tri-4 M1-Fin Dist.	0.20 nm
Max. Fleet Size	30	Boats			
Avg. Boat LOA	12.0	Metres		Target Race Time	60 Min.
Avg. Speed-Beat	6.0	Kt			
Avg. Speed-Run	10.0	Kt		Start-Line Len. Factor	110%
Avg. Speed-Reach	15.0	Kt		Calc. Start-Line Length	400 Metres
Avg. Tack Angle	80	Deg.		Calc. Fin.-Line Len.	110 Metres

Tri-2 is a 2-Mark, 5-Leg triangle course where the Start-Line Pin also serves as the 3rd Mark.

Tri-3 is the classic 3-Mark, 5-Leg triangle course. Both Tri-2 & Tri-3 courses finish at the Start-Line.

Tri-4 (shown) adds a 6th leg that is upwind of the windward Mark and requires a separate Finish Line.

9.1.2 Tri-4 Finish Leg Distance (0.05-6,076)

For the **Tri-4** course, the final windward leg distance is extended upwind of Mark 1. This extension is entered as a whole or decimal number between 0.05 and 6,076 Feet, Metres, or NM. With this value set to 0.05', the Finish Line Pin is effectively M1. The final windward leg is scaled up/down with the other legs to meet the Target Race Time.



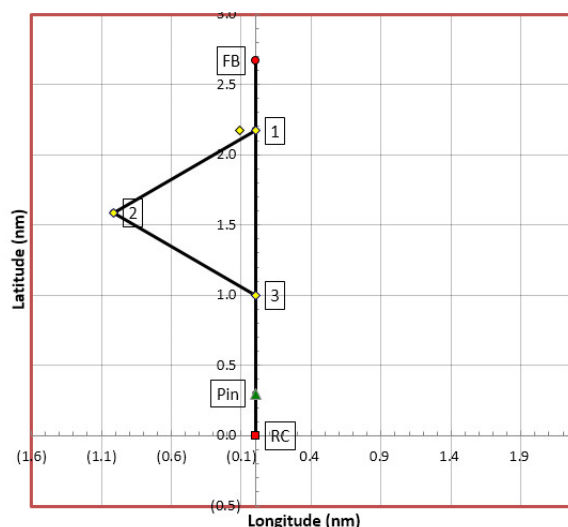
10. 505 Worlds Course (505)

The **505** Worlds Course contains two variations: DV-7 and DV-8 (shown) with both variations having the option of a 'Gate' (shown) or 'Line' start.

The sequences of the two variations are:

- DV-7: Start-1-3-1-2-3-1-3-Finish Downwind 7-legs)
- DV-8: Start-1-3-1-2-3-1-3-1-Finish Upwind (8-Legs)

Additional ezTrap triangle courses and variations are available in the Triangle and Lipton Challenge Cup courses – see the descriptions of the Lipton "T" and "O" courses.



10.1 505 Worlds Course Input Values

The common ezTrap Input Values are described in the Getting Started section of the manual.

This section described the Input Values that are unique to the **505** courses.

10.1.1 Course Types (DV-7 and DV-8)

Two variations of the 505 Worlds Course are supported, and can be selected from a Drop-down List:

INPUT VALUES									
Mag. Wind Direction	000	°M → °T	000	Course Type	DV-8				
Area Variation	-	W		Gate Start or Start Line	Gate				
				Mark 1 Included Angle	60	°			
				M1 Spacer Offset	200.00	Metres			
				M3 Offset	1.00	nm			
				FB Offset	0.50	nm			
				Gate Start Pin Offset	0.30	nm			
				Target Race Time	115	Min.			
				Start-Line Len. Factor	150%				
				Calc. Start-Line Length	460	Metres			
				Calc. Fin.-Line Len.	120	Metres			

DV-7 is a 7-leg triangle course with a downwind finish, and **DV-8** is an 8-leg triangle course with an upwind finish.

10.1.2 Gate Start or Start Line

Each course type has a choice of a traditional 'Start Line' or 'Gate' ("Rabbit") start.

10.1.3 Mark 1 Included Angle

The included angle at M1 parameter is variable between 45-70 degrees; however, it is typically set at 60 degrees for 505's.

10.1.4 505 Marks

Offset or spacing parameters (Ft., M, or NM) are used to position up to four marks. From the RC:

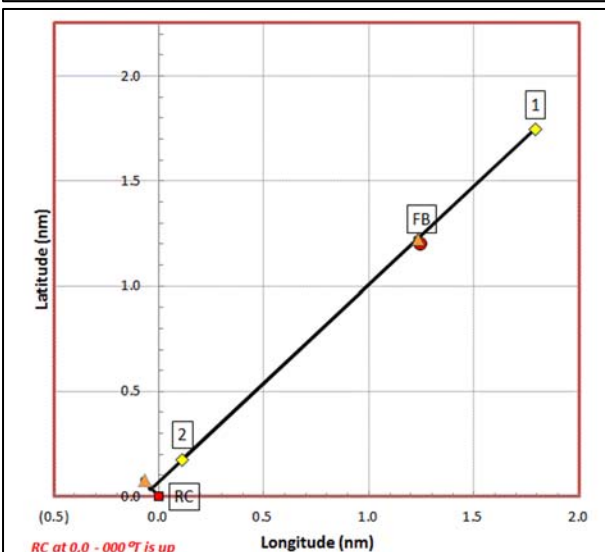
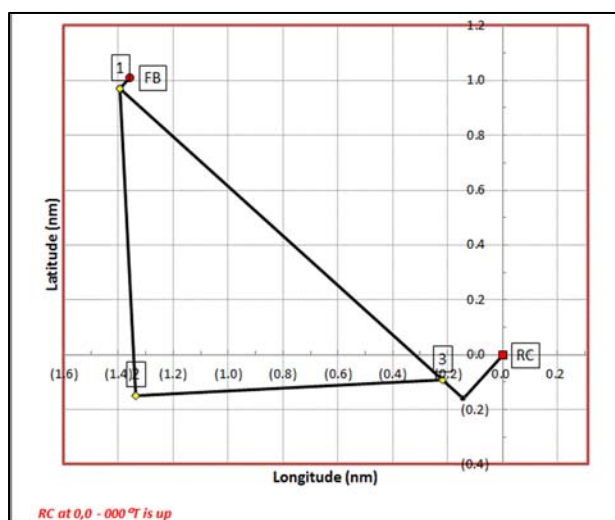
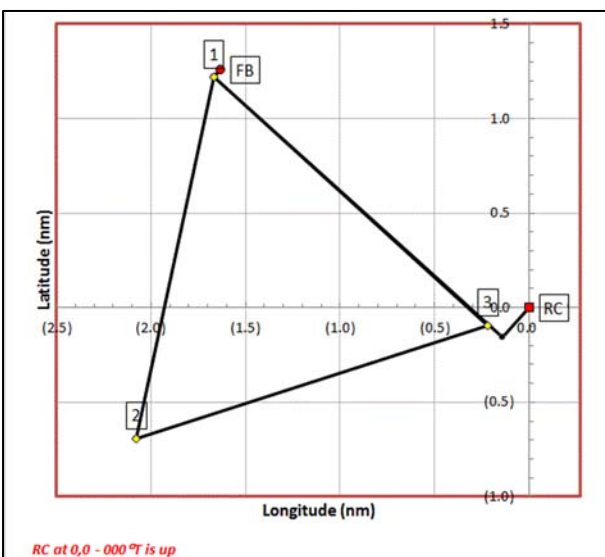
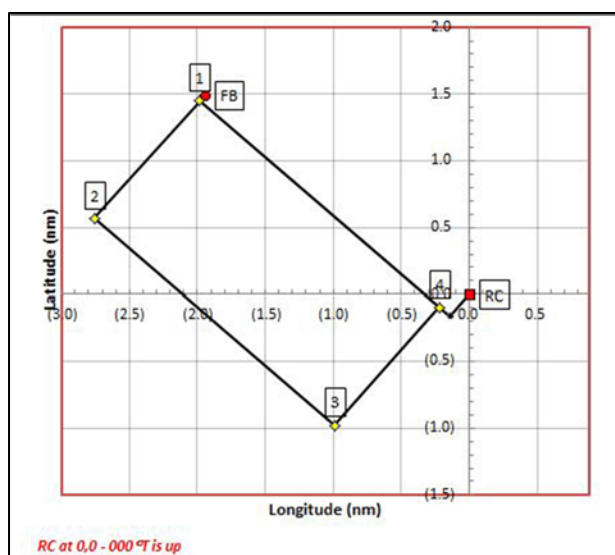
- M1 Spacer Offset is left of M1;
- M3 Offset is upwind of Start Pin (Gate) or MidPt of Start Line (Line);
- FB Offset is downwind from M3 (DV-7) or upwind of M1 (DV-8); and,
- Gate Start Pin Offset (Gate) is upwind of RC.



11. Lipton Challenge Cup Courses (R, T, O, and S)

The four Lipton Challenge Cup courses are described in this section, and the **LiptonS** course is also mentioned in the Windward/Leeward section. The Lipton Cup Family includes four course types:

- Rectangular (R-1, R-2, and R-3 variations);
- Equilateral Triangle (T-1, T-2, and T-3 variations);
- Isosceles Triangle (O); and,
- Windward/Leeward (S-1, S-2, and S-3 variations).



11.1 Rectangular Lipton R Course Input Values

The common ezTrap Input Values are described in the Getting Started section of the manual.

This section describes the Input Values that are unique to the **LiptonR** course – Course Type and Reach to W/L Leg Ratio.

In order to ensure a rectangular course, the Included Angle at Mark 1, and all other turns are pre-set to 90°.

INPUT VALUES			
Mag. Wind Direction	330	°M → °T	312
Area Variation	17.9	W	
Course Type	R-2		
Mark 1 Alignment	MidPt		
		M4 Offset	0.10 nm
	Degrees Minutes (decimal)		
RC Latitude	44	-	N
RC Longitude	64	-	W
Max. Fleet Size	30	Boats	
Avg. Boat LOA	12.0	Metres	
Avg. Speed-Beat	6.0	Kt	
Avg. Speed-Run	6.5	Kt	
Avg. Speed-Reach	7.0	Kt	
Avg. Tack Angle	90	Deg.	
Reach/1st Leg Ratio	62%		
Target Race Time	180 Min.		
Start-Line Len. Factor	110%		
Calc. Start-Line Length	400 Metres		
Calc. Fin.-Line Len.	110 Metres		

11.1.1 LiptonR Course Types

The user can select one of three variations of the Lipton R Course from the drop-down list values: R-1, R-2 or R-3 for once, twice, and three times around (5, 9, or 13 legs) the rectangular course with an upwind finish leg at Mark 1. Optionally, Marks 3 and 4 can be offset from the starting line.

11.1.2 LiptonR Reach to W/L Leg Ratio (50-150%)

ezTrap allows the RO to adjust the proportions of the rectangular course with the (Beam) Reach to Windward/Leeward ratio, which is entered as a whole or decimal percentage between 50-150%. A 50% value will result in the W/L legs twice as long as the Reach Legs, and a 100% value will result in a square. ROs can use 61.8% to design a course with Golden Rectangle (Phi) proportions.

11.2 Lipton Triangle T and O Course Input Values

INPUT VALUES			
Mag. Wind Direction	090	°M → °T	072
Area Variation	17.9	W	
Course Type	O		
M1 Alignment	MidPt		
		M3 Offset	0.10 nm
	Degrees Minutes (decimal)		
RC Latitude	44	-	N
RC Longitude	64	-	W
Max. Fleet Size	30	Boats	
Avg. Boat LOA	12.0	Metres	
Avg. Speed-Beat	5.0	Kt	
Avg. Speed-Run	6.0	Kt	
Avg. Speed-Reach	7.0	Kt	
Avg. Tack Angle	90	Deg.	
Target Race Time	180 Min.		
Start-Line Len. Factor	150%		
Calc. Start-Line Length	550 Metres		
Calc. Fin.-Line Len.	140 Metres		

The Equilateral Triangle **LiptonT** course and isosceles triangle **LiptonO** course have similar input values with the exception that the **LiptonT** course has three variations and no downwind (Run) legs.

- The **LiptonT** course is based on an equilateral triangle where all three internal angles are pre-set to 60° thereby making all 3-sides equal in length.
- The **LiptonO** course is based on an isosceles triangle where the first and third internal angles are pre-set to 45°, and the second to 90° thereby making it a right triangle where the two short sides equal in length.

11.2.1 LiptonT Course Types

The **LiptonT** course has three types that specify the number of rounds (1, 2 or 3) before an upwind finish at Mark 1.



11.3 Lipton Windward/Leeward S Course Input Values

The **LiptonS** course is supported by the ezTrap Windward/Leeward Course and has 1, 2, or 3 rounds followed by a variable length upwind finish.

INPUT VALUES					
Mag. Wind Direction	090	°M → °T	113	Course Type	WL-5
Area Variation	22.9	E		Marks 1&2 Align.	MidPt
	Degrees Minutes (decimal)			M2 Offset	0.20 nm
RC Latitude	41	16.000	S	WL3,5&7 % Fin Dist.	62% %
RC Longitude	174	49.000	E		
				Target Race Time	60 Min.
Max. Fleet Size	60	Boats			
Avg. Boat LOA	14.0	Feet			
Avg. Speed-Beat	8.0	Kt		Start-Line Len. Factor	150%
Avg. Speed-Run	16.0	Kt		Calc. Start-Line Length	1,270 Feet
Avg. Tack Angle	90	Deg.		Calc. Fin.-Line Len.	320 Feet

11.3.1 LiptonS Course Types

The **LiptonS** course types are supported with three of the five ezT rap Windward/Leeward course types:

- **WL-3** is the equivalent of S-1;
- **WL-5** is the equivalent of S-2;
- **WL-7** is the equivalent of S-3.

11.3.2 LiptonS Course Finish Leg Distance (20-150% of W/L Leg)

For the S-1, S-2, and S-3 courses, the final windward leg distance is extended upwind (or downwind) of Mark 2 based on a percentage of the W/L leg distance. For example, 100% is the equivalent of having the Finish Pin at M1.

The final leg is also included in the calculation of the M2-M1 W/L Leg distance to meet the Target Race Time.

12. ezTrap Support

12.1 Registered User Requirement Eliminated

Until 2020, ezTrap and any updates were distributed only to Registered Users who were limited, by the honor system, from making copies for resale or other distribution to others who were not Registered Users. As of October 2020, ezTrap is available for free download from the <https://www.sailwave.com/> website and may be shared without limitations indefinitely (i.e., no expiry date). However, MS Excel® security and other provisions will continue to prevent unintentional changes or reverse engineering.

12.2 On-going Development and Support TBD

With the transfer of ezTrap to [Sailwave](https://www.sailwave.com/), ongoing support and development details are coordinated by [Sailwave](https://www.sailwave.com/) personnel. These topics will be discussed via the Sailwave User Group ezTrap Forum at <https://forum.sailingresults.co.uk/c/eztrap-support>



12.3 Compatibility with Older Versions of Excel®

ezTrap is developed and maintained with the MS 365 Excel® (64-bit) service. It uses the Macro-enabled Workbook format (.xlsm filename extension). The Excel® 97-2003 and older formats (.xls) are no longer supported. Further, the ezTrap v2x .xlsm file 'saved as' a 97-2003 .xls version may not work properly. Subsequent versions of MS Excel® (e.g., 2007, 2010, and later) should work without modifications.

12.3.1 Mac OS

Users have reported that ezTrap works with Mac OS and MS Excel® Version 2011 and later; however, thorough testing has not been conducted.

12.4 Version History

Version	Date	Description
v8.0	February 25, 2010	Prepared for ezTrap Beta v8.0 Release
v8.9	March 15, 2010	Updated for Beta v8.9 Release that supports global Lat. & Long., variable Finish Leg, and other improvements
v9.2	April 2, 2010	Updated for Beta v9.2 that supports the Optimist Worlds Course, and other improvements.
v10.0	April 7, 2010	Updated for First Release – v10.0
v10.1	May 15, 2010	Metres, Feet or NM option for some Input Values, removal of Rel-HDGs from Course Information, Start Line Length formula adjusted to round up to next 10 units, Trapezoid course – increased Finish Leg Angle range.
v10.2	June 15, 2010	Improved algorithm for meeting Target Race Times with Trapezoid Course. Windward/Leeward Course Added.
v11.0	April 30, 2011	Reorganized and updated for all course families. New 7-leg Trapezoid Course, Lipton Challenge Cup, and Yacht Club Courses added.
v11.2a	May 15, 2011	New RS:X Windsurfer Trapezoid and W/L Slalom courses added. Minor edit corrections to User's Manual.
v11.2b	May 31, 2011	Excel® 2003 (.xls) support described. Minor edit corrections to User's Manual.
v12.0	April 7, 2012	Major update V12 for new Bundles and Features including Trap6 1a option, Estimated Sailing Times by Leg, and POS Statistics.
V13.1	April 7, 2013	Improved ease of use, formatting, and consolidation into one application with dramatic price reductions. Macros added for hiding or displaying courses and notes.



Version	Date	Description
V13.3	July 9, 2013	Support for North or Wind Up views in Trapezoid course.
V13.505	March 15, 2015	Support for 505 World Championships course added.
V13.6	June 10, 2015	Support for Optimist USODA course added (in addition to IODA).
V17.1	April 7, 2017	Improved ease of use and updated User's Manual
V17.2	April 5, 2018	Updated User's Manual
V20	January 2020	ezTrap v20 and documentation updated for free and unrestricted use. Downloads from http://bottrell.ca/ will no longer be available after early 2021.
V21	October 2020	ezTrap v21 and documentation updated for transfer to Sailwave Race Management resources at Sailwave.com. 
V21.1	January 2021	New functions added – generation of TRAP6 Templates and Export of Course Display; Updated illustrations; Edited for consistent use of 'metres'; Club course cosmetic bug fixed – Fixed "X" Mark name not displayed; Added P/S roundings to Club course; Optional North-Up or Wind-Up course plots for all courses.
V23.1	February 2023	Club Course Fixed Marks expanded from 12 to 21.

12.5 Acknowledgements

Special thanks to:

- Ric Hattin, P.Eng., CS30 Racer and Regatta Official, Seabright, Nova Scotia, Canada for helping with ezTrap design, Alpha & Beta Testing, and the business model.
- Jon Peltier, Sc.D., MS Excel® MVP, [Peltier Technical Services](#), Massachusetts, for help with the plotting and chart macros, and troubleshooting the Excel® 2003/2010 compatibility problems.
- Chris Veness, [Moveable-Type Ltd.](#), Cambridge, UK for illustrating some of the underlying theory and formulae for calculations involving latitude & longitude.
- Alan Keen, Laser Grand Master and Optimist PRO, Cape Town, South Africa for help with the Optimist Worlds Course and Lipton Challenge Cup Course Family.
- Mike Pothier, P.Eng., J29 Racer and Regatta Official, Halifax, Nova Scotia for helping with ezTrap Beta Testing and compatibility with different versions of MS Excel®.
- Huw Pearce, Sailwave User Guide author and webmaster, and Jon Eskdale, Sailwave software author and technical support, for their guidance and support during the transition to Sailwave.
- And thanks to the many Beta testers and users around the world.

12.6 About the Developer

About the Developer: Ed Bottrell is a life-long boater with keelboat racing and cruising experience in the Great Lakes, South Pacific, and Atlantic Canada. He has been a part of the race management of numerous local, regional, national, and international regattas for dinghies, keelboats, and ocean racers. He is a former Canadian Yachting Association (now Sail Canada) Senior Instructor-Evaluator for the Cruising & Power Boat Programs, Club Race Officer, and a Coastal Navigation and Marine Radio Instructor. Ed has a BSIE degree in industrial and systems engineering from Kettering University, Flint, MI, USA and has held professional certifications in management consulting (FCMC-Life Member), project management (PMP), and information systems (CDP, CCP, ISP). Ed is retired and lives in Halifax, Nova Scotia, Canada.



12.7 Disclaimers

Every reasonable effort has been made to ensure that the functional and graphical results of ezTrap are correct; however, no liability is assumed, and users shall have the final responsibility for designing and managing any racecourse. This User's Manual contains some relevant observations and notes about race management but is not intended to be an instructional guide.



13. Glossary of Terms

Bearing (BRG)	Direction of a mark or other object measured in Magnetic ($^{\circ}$ M) or True ($^{\circ}$ T) degrees (000-359). See Relative Bearings and Headings.
Course-Setter	Race Committee person responsible for designing and managing the set-up of the Course. May also be the Race Officer or Principal Race Officer.
Deviation	Local effect on a ship's magnetic compass caused by iron, magnetic fields, and other on-board factors. Deviation will vary depending on the heading of the ship. Any bearings or headings from/to the ship's magnetic compass should be corrected with the ship's Deviation Card before use as Magnetic Readings. Hand-held magnetic compasses are not generally affected by Deviation.
Drift	The speed of a current in knots (kt). See Set. The RO can compensate for drift by varying the wind direction.
Finish Boat (FB)	The race committee boat at the Finish-Line, which includes a Finish-Pin at the opposite end.
GPS	Global Positioning by Satellite system. Provides Latitude, Longitude, Time, Bearings, and other information to hand-held or installed GPS electronic devices. It is important that all GPS units used for a Regatta be set (and verified) to the same parameters (e.g., True or Magnetic Directions, GPS Reference Datum, measurement units, etc.
Gybe or Jibe	Turning the boat through the wind on the stern requiring the mainsail and boom to move to the opposite side.
Heading (HDG)	Direction the boat is pointing or moving measured in Magnetic ($^{\circ}$ M) or True ($^{\circ}$ T) degrees (000-359 $^{\circ}$). See Relative Bearings and Headings.
Knot (kt)	Unit of speed. 1.0 knot = Nautical Miles per Hour = 1.15 Statute Mile per Hour = 1.85 Kilometres per hour.
Latitude	Imaginary line on the globe parallel to the equator. The location of the line is the angular measurement, expressed in degrees (0-90 $^{\circ}$), North or South of the equator. The angle is formed by the plane of the equator and a line from the center of the earth to any point on the imaginary line of latitude. In combination with Longitude, will define a unique point on the surface of the globe. A Nautical Mile (NM) is defined as one minute of Latitude on the surface of the earth, which is also equal to 1,852 Metres or 6,076 Feet. Latitude scales (i.e., degrees and decimal minutes) are shown on the left and right side of Nautical Charts and are used for measuring distance.
Leeward	Away from the wind.
Leeward Mark	The mark at the end of a downwind run.
Longitude	Imaginary line on the globe that includes the North and South Poles – also known as a Great Circle. The location of the imaginary line is the angular measurement, expressed in degrees (0-180 $^{\circ}$), East or West of the Prime Meridian that runs through Greenwich, England. In combination with Latitude, will define a unique point on the surface of the globe. Longitudes are shown on the top and bottom of Nautical Charts. Longitudinal distances vary depending on the Latitude, and therefore are not used for measuring distance.
Magnetic Declination	Same as Variation. Difference between magnetic and true North, which is measured in degrees East or West for a given local area. See Variation.
Mark	A buoy or floating object designated as a turning point on the racecourse. Often a brightly colored, inflated tetrahedron.
Mark Boat	A race committee support boat responsible for setting (and moving) one or more marks.



Metre (m)	Common metric measure of distance and used by some ROs for some distance measures. ezTrap uses conversion factors based on: 1.0 NM = 6,076 Feet = 1,852 Metres.	<table> <tr> <th>NM</th><th>Metres</th><th>Feet</th></tr> <tr> <td>1.00</td><td>1,852</td><td>6,076</td></tr> <tr> <td>0.02</td><td>30</td><td>100</td></tr> <tr> <td>0.08</td><td>152</td><td>500</td></tr> <tr> <td>0.16</td><td>305</td><td>1,000</td></tr> <tr> <td>0.03</td><td>50</td><td>164</td></tr> <tr> <td>0.05</td><td>100</td><td>328</td></tr> <tr> <td>0.08</td><td>150</td><td>492</td></tr> <tr> <td>0.05</td><td>93</td><td>304</td></tr> <tr> <td>0.10</td><td>185</td><td>608</td></tr> <tr> <td>0.15</td><td>278</td><td>911</td></tr> </table>	NM	Metres	Feet	1.00	1,852	6,076	0.02	30	100	0.08	152	500	0.16	305	1,000	0.03	50	164	0.05	100	328	0.08	150	492	0.05	93	304	0.10	185	608	0.15	278	911
NM	Metres	Feet																																	
1.00	1,852	6,076																																	
0.02	30	100																																	
0.08	152	500																																	
0.16	305	1,000																																	
0.03	50	164																																	
0.05	100	328																																	
0.08	150	492																																	
0.05	93	304																																	
0.10	185	608																																	
0.15	278	911																																	
Nautical Mile (NM)	Common measure of nautical distance, especially when working with nautical charts and navigation. 1.0 NM = 6,076 Feet = 1,852 Metres. Also equal to one minute of Latitude. Approximately 115% longer than a statute mile, and 185% longer than a Kilometre.																																		
Pin	A buoy, typically a ball, cylinder or inflatable pyramid marking the end of the Start and Finish Lines, and opposite an RC or Finish Boat.																																		
Port	Left side of a boat facing the bow. Turning to Port means turning in the direction of the left side of the boat when facing the bow – even when operating astern.																																		
Race Committee (RC)	The people who organize and conduct the race(s). Also used as Race Committee Boat to indicate the boat with the RO responsible for running the race, and the source of visual, sound, and radio signals. See Signals Boat.																																		
Race Officer (RO)	Race Officer or Principal Race Officer (PRO) for the race. On the water responsibility for course, race management resources, and the conduct of the race(s). May also be the Course Setter.																																		
Relative BRG or HDG	Relative bearings or headings are with reference to the bow of the boat as 000 and are expressed in degrees (000-180 degrees) to Port or Starboard.																																		
Set	The direction (000-359°) of a current. See Drift.																																		
Signals Boat	Same as RC Boat. Boat with the RO responsible for running the race, and the source of visual, sound, and radio signals. Usually forms one end of the Start-Line. See RC.																																		
Starboard	Right side of a boat facing the bow. Turning to Starboard means turning in the direction of the right side of the boat when facing the bow – even when operating astern.																																		
Time	Conventional definition of local time in hours, minutes, and seconds. 24-hour time system, sometimes with reference to Universal Coordinated Time (UCT or ZULU time), typically used for navigation records. Local time may be Standard or Daylight-Saving Time, but UTC/ZULU Time never observes DST.																																		
Variation	Same as magnetic declination and usually shown on charts in the compass rose. Variation is the difference between magnetic and true North, which is measured in degrees East or West for a given local area. Variation tends to change over time.																																		
Weather Mark	Same as Windward Mark. Designated upwind racing buoy at the end of a beat into the wind and known as Mark 1. See Windward Mark.																																		
Windward	Towards the wind. Sailing to windward involves tacking, also known as beating. See Tacking and Beating.																																		
Windward Mark	Same as Weather Mark. Designated upwind racing buoy at the end of a beat into the wind and known as Mark 1. See Weather Mark.																																		
Wing Mark	Same as Gybe Mark. Rounding the Gybe mark involves a Gybe.																																		

