MCP_code.Rmd

Julia Sirois

11/15/2022

Introduction

The goal of this project is to analyze telemetry data collected over the 2022 field season on six wood turtles (3 males and 3 females), to look for patterns and differences between their home ranges. This Markdown file will consist of the code necessary to run two analyses. The first relationship being explored is MCP home range area of males vs the MCP area of females. I hypothesize that male wood turtles will occupy a larger home range than female turtles do, as some literature suggests male woof turtles often have larger home ranges. The second relationship I would like to explore is the difference in size between each turtles MCP area at 75% vs their MCP area at 95%. I am interested in exploring this relationship to see if wood turtles have concentrated home ranges.

Getting started:

Activate necessary packages and clear R's brain

```
rm(list = ls())
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.4.0     v purrr   0.3.5
## v tibble  3.1.8     v dplyr   1.0.10
## v tidyr   1.2.1     v stringr 1.4.1
## v readr   2.0.1     v forcats 0.5.1
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(here)
```

```
## here() starts at /home/jesiro19/Biostats/CapDAP_Turtles
```

```
library(adehabitatHR) #home range functions
```

```
## Loading required package: sp
```

```
## Loading required package: deldir
```

```
## deldir 0.2-10      Nickname: "Morpheus and Euripides"
```

```
##
##      Note 1: As of version 0.2-1, error handling in this
##      package was amended to conform to the usual R protocol.
##      The deldir() function now actually throws an error
```

```
##      when one occurs, rather than displaying an error number
##      and returning a NULL.
##
##      Note 2:  As of version 0.1-29 the arguments "col"
##      and "lty" of plot.deldir() had their names changed to
##      "cmpnt_col" and "cmpnt_lty" respectively basically
##      to allow "col" and and "lty" to be passed as "..."
##      arguments.
##
##      Note 3: As of version 0.1-29 the "plotit" argument
##      of deldir() was changed to (simply) "plot".
##
##      See the help for deldir() and plot.deldir().

## Loading required package: ade4

## Loading required package: adehabitatMA

## Registered S3 methods overwritten by 'adehabitatMA':
##   method                    from
##   print.SpatialPixelsDataFrame sp
##   print.SpatialPixels       sp

## Loading required package: adehabitatLT

## Loading required package: CircStats

## Loading required package: MASS

##
## Attaching package: 'MASS'

## The following object is masked from 'package:dplyr':
##
##     select

## Loading required package: boot

##
## Attaching package: 'adehabitatLT'

## The following object is masked from 'package:dplyr':
##
##     id
```

```r
library(rgdal) #spatial data
```

```
## rgdal: version: 1.5-23, (SVN revision 1121)
## Geospatial Data Abstraction Library extensions to R successfully loaded
## Loaded GDAL runtime: GDAL 3.0.4, released 2020/01/28
## Path to GDAL shared files: /usr/share/gdal
## GDAL binary built with GEOS: TRUE
## Loaded PROJ runtime: Rel. 7.0.0, March 1st, 2020, [PJ_VERSION: 700]
## Path to PROJ shared files: /home/jesiro19/.local/share/proj:/usr/share/proj
## PROJ CDN enabled: FALSE
## Linking to sp version:1.4-5
## To mute warnings of possible GDAL/OSR exportToProj4() degradation,
## use options("rgdal_show_exportToProj4_warnings"="none") before loading rgdal.
```

```
library(ggfortify)
```

Pull in the data

This dataset has been adjusted in ArcGIS so that the coordinate measurements are in UTM (meters) instead of decimal degrees.

```
turtles <- read.csv(here("Data", "updated_turtle_locations.csv"))
```

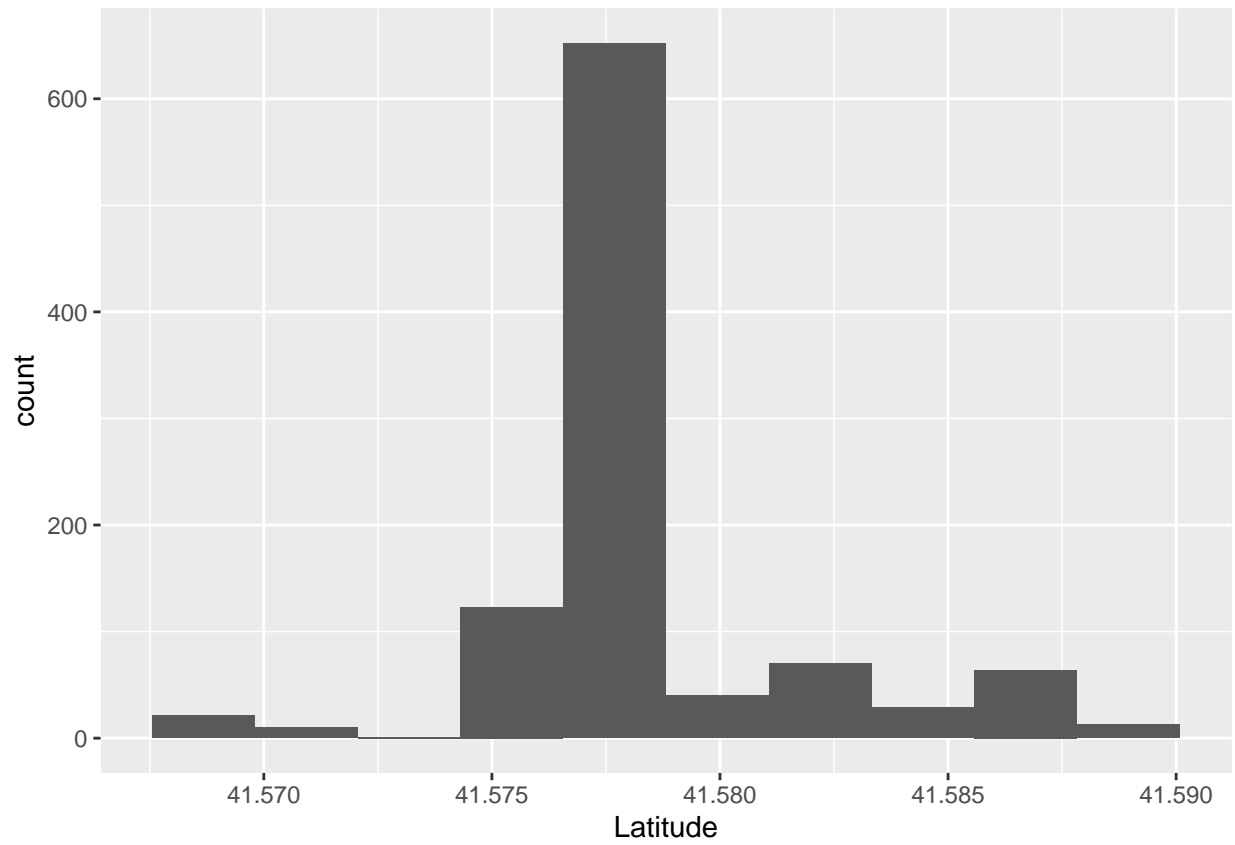## Check the data for errors

```
str(turtles)
```

```
## 'data.frame':    1023 obs. of  16 variables:
##  $ OID_        : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ Date        : chr  "5/12/2022 0:00:00" "5/13/2022 0:00:00" "5/13/2022 0:00:00" "5/13/2022 0:00:00"
##  $ Time        : chr  "19:00" "7:00" "11:00" "19:00" ...
##  $ Latitude    : num  41.6 41.6 41.6 41.6 41.6 ...
##  $ Longitude   : num  -71.7 -71.7 -71.7 -71.7 -71.7 ...
##  $ Turtle_ID   : chr  "L1R2" "L1R2" "L1R2" "L1R2" ...
##  $ Turtle_sex  : chr  "male" "male" "male" "male" ...
##  $ Altitude    : num  10.17 3.66 -15.46 4.21 16.19 ...
##  $ Duration    : num  22 66 18.3 45 35.7 ...
##  $ Temperature : num  26.3 20 24 28.2 20.7 ...
##  $ Voltage     : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ DOP         : num  2.2 2.1 1.93 2.33 2.33 ...
##  $ Satellites  : num  5 4.5 4.67 4.33 4.33 ...
##  $ EST_Time    : chr  "5/12/2022 19:00:00" "5/13/2022 7:00:00" "5/13/2022 11:00:00" "5/13/2022 19:00:0
##  $ NEAR_FID    : int  2 2 2 4 2 2 2 4 2 2 ...
##  $ NEAR_DIST   : num  32.31 15.87 2.45 7.44 7.48 ...
```
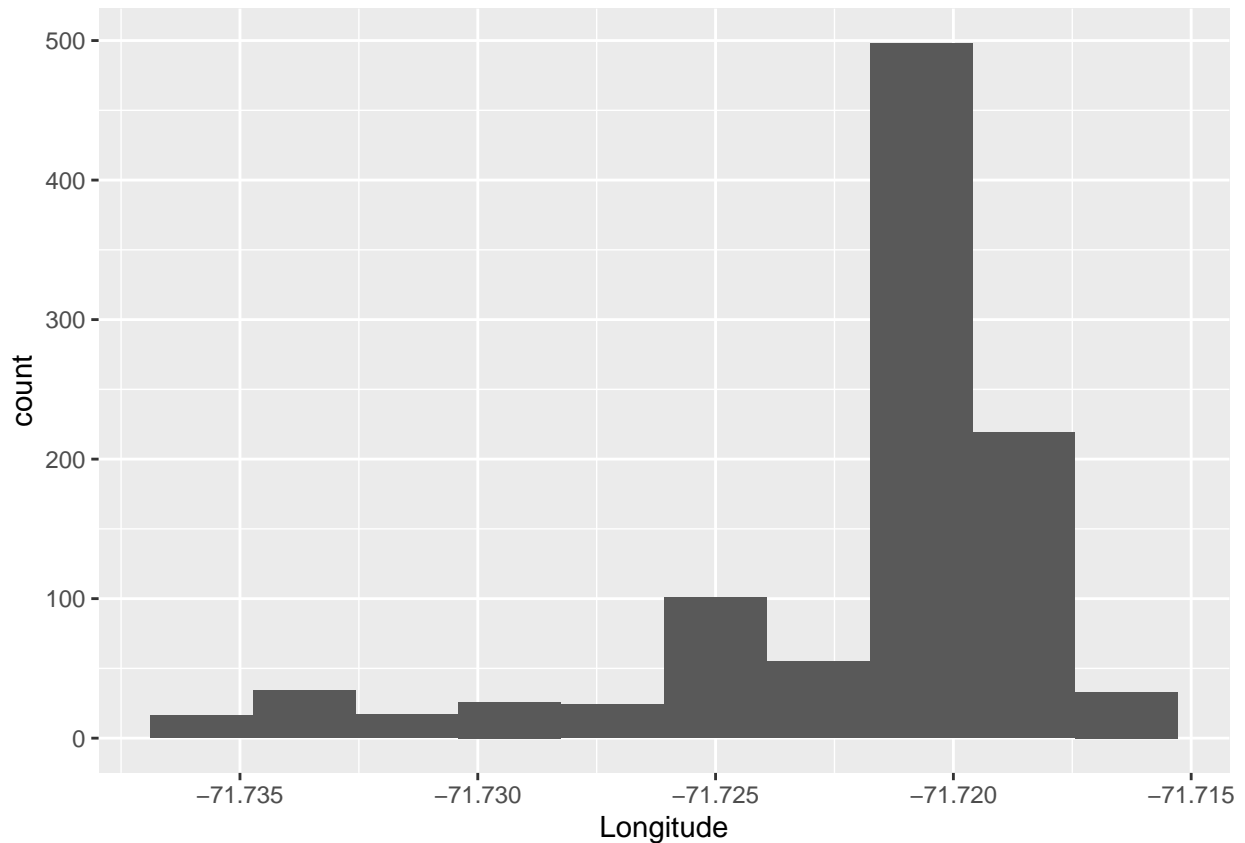
Check Latitudes and Longitudes

Using a histogram to visualize these columns will be sufficient. I expect some variation but nothing too drastic as these turtles all live in the same management area.

```
ggplot(turtles, aes(x = Latitude)) +
  geom_histogram(bins = 10)
```

```
ggplot(turtles, aes(x = Longitude)) +
  geom_histogram(bins = 10)
```

Perfect.

Create a subset consisting of the Turtle IDs, Lats and Longs.

```
turtles.sp <- turtles[, c("Turtle_ID", "Latitude", "Longitude")]
```

R is reading the Lats and Longs as numeric data and needs to be told that those columns represent spacial data.

```
library(sp)
sp::coordinates(turtles.sp)<-turtles.sp[, c("Longitude", "Latitude")]
proj4string(turtles.sp)<-CRS("+proj=longlat +datum=WGS84") #sets projection
```

Now convert the spatial coordninates into UTM so the measurements are in meters and not degrees.

```
utm_sp <-spTransform(turtles.sp, CRS("+proj=utm +zone=19 ellps=WGS84")) #reprojects to UTM
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition
```

```
utm_sp
```

```
##               coordinates Turtle_ID Latitude Longitude
## 1    (273236.8, 4606589)      L1R2 41.57883 -71.72012
## 2    (273219.6, 4606454)      L1R2 41.57761 -71.72027
## 3    (273238.2, 4606456)      L1R2 41.57763 -71.72005
## 4    (273243.8, 4606485)      L1R2 41.57789 -71.71999
## 5    (273235.2, 4606487)      L1R2 41.57790 -71.72010
## 6    (273241.4, 4606492)      L1R2 41.57795 -71.72002
```

```
## 7    (273232.1, 4606443)    L1R2 41.57751 -71.72012
## 8    (273242.5, 4606481)    L1R2 41.57785 -71.72001
## 9    (273211.4, 4606593)    L1R2 41.57886 -71.72042
## 10   (273219.6, 4606548)    L1R2 41.57845 -71.72031
## 11   (273215.6, 4606581)    L1R2 41.57875 -71.72037
## 12   (273221.4, 4606567)    L1R2 41.57862 -71.72029
## 13   (273222.1, 4606561)    L1R2 41.57857 -71.72028
## 14   (273242.7, 4606477)    L1R2 41.57782 -71.72000
## 15   (273241.6, 4606436)    L1R2 41.57745 -71.72000
## 16   (273245.4, 4606433)    L1R2 41.57743 -71.71995
## 17     (273259, 4606449)    L1R2 41.57757 -71.71980
## 18   (273247.6, 4606443)    L1R2 41.57751 -71.71993
## 19   (273245.2, 4606441)    L1R2 41.57749 -71.71996
## 20     (273253, 4606449)    L1R2 41.57757 -71.71987
## 21     (273251, 4606451)    L1R2 41.57759 -71.71989
## 22   (273282.9, 4606468)    L1R2 41.57774 -71.71952
## 23   (273169.1, 4606442)    L1R2 41.57749 -71.72087
## 24   (273169.4, 4606428)    L1R2 41.57735 -71.72086
## 25   (273165.4, 4606453)    L1R2 41.57758 -71.72092
## 26   (273167.3, 4606441)    L1R2 41.57748 -71.72089
## 27   (273181.2, 4606411)    L1R2 41.57720 -71.72072
## 28   (273217.8, 4606417)    L1R2 41.57727 -71.72028
## 29   (273201.4, 4606423)    L1R2 41.57732 -71.72048
## 30   (273192.3, 4606415)    L1R2 41.57725 -71.72058
## 31   (273162.6, 4606457)    L1R2 41.57762 -71.72095
## 32   (273195.7, 4606431)    L1R2 41.57739 -71.72055
## 33   (273180.7, 4606442)    L1R2 41.57749 -71.72073
## 34   (273166.6, 4606441)    L1R2 41.57747 -71.72090
## 35   (273167.2, 4606445)    L1R2 41.57751 -71.72089
## 36   (273163.5, 4606435)    L1R2 41.57742 -71.72094
## 37   (273170.6, 4606440)    L1R2 41.57747 -71.72085
## 38   (273203.3, 4606449)    L1R2 41.57756 -71.72046
## 39   (273177.5, 4606423)    L1R2 41.57731 -71.72076
## 40   (273167.5, 4606423)    L1R2 41.57731 -71.72088
## 41   (273174.5, 4606431)    L1R2 41.57738 -71.72080
## 42   (273172.9, 4606433)    L1R2 41.57740 -71.72082
## 43   (273202.4, 4606265)    L1R2 41.57590 -71.72041
## 44   (273157.4, 4606254)    L1R2 41.57579 -71.72094
## 45   (273172.9, 4606261)    L1R2 41.57585 -71.72076
## 46   (273172.1, 4606270)    L1R2 41.57593 -71.72077
## 47   (273200.6, 4606300)    L1R2 41.57621 -71.72044
## 48   (273190.6, 4606425)    L1R2 41.57733 -71.72061
## 49   (273201.6, 4606413)    L1R2 41.57723 -71.72047
## 50   (273391.7, 4606508)    L1R2 41.57814 -71.71823
## 51     (273300, 4606399)    L1R2 41.57713 -71.71929
## 52   (273279.2, 4606432)    L1R2 41.57742 -71.71955
## 53   (273269.7, 4606418)    L1R2 41.57729 -71.71966
## 54   (273267.8, 4606426)    L1R2 41.57737 -71.71968
## 55   (273251.8, 4606434)    L1R2 41.57744 -71.71988
## 56   (273266.1, 4606420)    L1R2 41.57731 -71.71970
## 57   (273192.8, 4606530)    L1R2 41.57828 -71.72062
## 58   (273191.8, 4606539)    L1R2 41.57836 -71.72064
## 59   (273170.4, 4606556)    L1R2 41.57851 -71.72090
## 60   (273175.3, 4606551)    L1R2 41.57846 -71.72084
```

```
## 61  (273161.1, 4606554)   L1R2 41.57849 -71.72101
## 62  (273169.6, 4606553)   L1R2 41.57848 -71.72091
## 63  (273190.1, 4606526)   L1R2 41.57825 -71.72065
## 64  (273169.8, 4606551)   L1R2 41.57846 -71.72090
## 65  (273172.1, 4606543)   L1R2 41.57839 -71.72087
## 66  (273200.3, 4606426)   L1R2 41.57735 -71.72049
## 67  (273168.9, 4606435)   L1R2 41.57742 -71.72087
## 68  (273173.4, 4606427)   L1R2 41.57734 -71.72081
## 69  (273161.2, 4606439)   L1R2 41.57746 -71.72097
## 70  (273231.2, 4606445)   L1R2 41.57753 -71.72013
## 71  (273222.5, 4606421)   L1R2 41.57731 -71.72022
## 72  (273213.1, 4606427)   L1R2 41.57736 -71.72034
## 73  (273216.1, 4606406)   L1R2 41.57717 -71.72029
## 74  (273212.3, 4606409)   L1R2 41.57720 -71.72034
## 75  (273211.9, 4606405)   L1R2 41.57716 -71.72035
## 76  (273210.8, 4606401)   L1R2 41.57713 -71.72036
## 77    (273219, 4606395)   L1R2 41.57707 -71.72026
## 78  (273204.6, 4606397)   L1R2 41.57709 -71.72043
## 79  (273165.6, 4606454)   L1R2 41.57759 -71.72092
## 80  (273163.6, 4606439)   L1R2 41.57745 -71.72094
## 81  (273160.2, 4606443)   L1R2 41.57749 -71.72098
## 82  (273173.4, 4606451)   L1R2 41.57756 -71.72082
## 83  (273217.7, 4606391)   L1R2 41.57704 -71.72027
## 84    (273168, 4606434)   L1R2 41.57741 -71.72088
## 85  (273150.4, 4606446)   L1R2 41.57751 -71.72110
## 86  (273164.8, 4606452)   L1R2 41.57757 -71.72093
## 87    (273158, 4606450)   L1R2 41.57755 -71.72101
## 88  (273168.7, 4606452)   L1R2 41.57757 -71.72088
## 89  (273169.3, 4606431)   L1R2 41.57738 -71.72086
## 90    (273168, 4606432)   L1R2 41.57739 -71.72088
## 91  (273166.9, 4606438)   L1R2 41.57745 -71.72090
## 92  (273173.5, 4606441)   L1R2 41.57747 -71.72082
## 93  (273186.9, 4606486)   L1R2 41.57788 -71.72068
## 94  (273175.7, 4606486)   L1R2 41.57788 -71.72081
## 95  (273183.6, 4606476)   L1R2 41.57779 -71.72071
## 96  (273295.1, 4606351)   L1R2 41.57670 -71.71933
## 97  (273203.6, 4606555)   L1R2 41.57851 -71.72050
## 98  (273192.8, 4606557)   L1R2 41.57852 -71.72063
## 99  (273197.3, 4606547)   L1R2 41.57843 -71.72057
## 100   (273197, 4606539)   L1R2 41.57836 -71.72057
## 101 (273177.2, 4606538)   L1R2 41.57835 -71.72081
## 102 (273177.8, 4606558)   L1R2 41.57853 -71.72081
## 103 (273169.4, 4606552)   L1R2 41.57847 -71.72091
## 104 (273170.5, 4606535)   L1R2 41.57832 -71.72089
## 105   (273175, 4606554)   L1R2 41.57849 -71.72084
## 106 (273168.3, 4606536)   L1R2 41.57833 -71.72092
## 107 (273177.7, 4606551)   L1R2 41.57846 -71.72081
## 108 (273179.6, 4606542)   L1R2 41.57839 -71.72078
## 109 (273159.5, 4606529)   L1R2 41.57826 -71.72102
## 110 (273174.6, 4606537)   L1R2 41.57834 -71.72084
## 111 (273178.6, 4606546)   L1R2 41.57842 -71.72080
## 112 (273194.8, 4606433)   L1R2 41.57741 -71.72056
## 113 (273172.9, 4606437)   L1R2 41.57744 -71.72082
## 114 (273132.6, 4606498)   L1R4 41.57797 -71.72133
```

```
## 115    (273208, 4606478)       L1R4 41.57782 -71.72042
## 116  (273220.8, 4606464)       L1R4 41.57770 -71.72026
## 117  (273131.4, 4606488)       L1R4 41.57788 -71.72134
## 118    (273133, 4606485)       L1R4 41.57786 -71.72132
## 119  (273139.4, 4606488)       L1R4 41.57789 -71.72124
## 120    (273135, 4606486)       L1R4 41.57787 -71.72130
## 121  (273136.4, 4606483)       L1R4 41.57784 -71.72128
## 122  (273134.5, 4606484)       L1R4 41.57785 -71.72130
## 123  (273143.7, 4606501)       L1R4 41.57800 -71.72120
## 124  (273129.5, 4606485)       L1R4 41.57785 -71.72136
## 125  (273140.3, 4606484)       L1R4 41.57786 -71.72123
## 126    (273138, 4606487)       L1R4 41.57787 -71.72126
## 127  (273140.9, 4606487)       L1R4 41.57788 -71.72123
## 128  (273133.1, 4606473)       L1R4 41.57775 -71.72131
## 129  (273139.9, 4606485)       L1R4 41.57786 -71.72124
## 130  (273224.8, 4606474)       L1R4 41.57778 -71.72022
## 131    (273139, 4606472)       L1R4 41.57774 -71.72124
## 132  (273132.7, 4606457)       L1R4 41.57761 -71.72131
## 133  (273144.9, 4606480)       L1R4 41.57782 -71.72118
## 134  (273124.6, 4606486)       L1R4 41.57786 -71.72142
## 135  (273107.7, 4606489)       L1R4 41.57789 -71.72162
## 136  (273111.8, 4606495)       L1R4 41.57794 -71.72158
## 137    (273118, 4606501)       L1R4 41.57800 -71.72151
## 138  (273120.8, 4606510)       L1R4 41.57808 -71.72148
## 139  (273116.8, 4606506)       L1R4 41.57804 -71.72152
## 140  (273116.2, 4606505)       L1R4 41.57803 -71.72153
## 141  (273143.8, 4606471)       L1R4 41.57774 -71.72119
## 142  (273144.7, 4606468)       L1R4 41.57771 -71.72117
## 143  (273144.5, 4606469)       L1R4 41.57772 -71.72118
## 144  (273138.9, 4606471)       L1R4 41.57773 -71.72124
## 145  (273129.9, 4606474)       L1R4 41.57776 -71.72135
## 146  (273143.8, 4606481)       L1R4 41.57783 -71.72119
## 147  (273138.7, 4606477)       L1R4 41.57779 -71.72125
## 148  (273137.4, 4606477)       L1R4 41.57779 -71.72126
## 149  (273139.6, 4606476)       L1R4 41.57778 -71.72124
## 150  (273138.8, 4606470)       L1R4 41.57772 -71.72124
## 151  (273140.8, 4606473)       L1R4 41.57775 -71.72122
## 152  (273116.9, 4606502)       L1R4 41.57801 -71.72152
## 153  (273117.3, 4606503)       L1R4 41.57802 -71.72152
## 154  (273103.2, 4606507)       L1R4 41.57805 -71.72169
## 155  (273088.3, 4606517)       L1R4 41.57813 -71.72187
## 156    (273082, 4606517)       L1R4 41.57814 -71.72194
## 157  (273083.9, 4606517)       L1R4 41.57813 -71.72192
## 158  (273084.8, 4606510)       L1R4 41.57807 -71.72191
## 159    (273212, 4606464)       L1R4 41.57769 -71.72037
## 160    (273145, 4606479)       L1R4 41.57781 -71.72117
## 161  (273142.5, 4606480)       L1R4 41.57782 -71.72120
## 162  (273148.5, 4606477)       L1R4 41.57780 -71.72113
## 163  (273138.8, 4606487)       L1R4 41.57788 -71.72125
## 164  (273128.8, 4606494)       L1R4 41.57794 -71.72137
## 165    (273139, 4606489)       L1R4 41.57790 -71.72125
## 166  (273122.8, 4606503)       L1R4 41.57802 -71.72145
## 167  (273115.3, 4606504)       L1R4 41.57803 -71.72154
## 168  (273115.1, 4606511)       L1R4 41.57809 -71.72154
```

```
## 169 (273123.6, 4606513)    L1R4 41.57811 -71.72144
## 170 (273128.7, 4606508)    L1R4 41.57806 -71.72138
## 171 (273127.9, 4606508)    L1R4 41.57807 -71.72139
## 172 (273116.9, 4606510)    L1R4 41.57808 -71.72152
## 173   (273170, 4606491)    L1R4 41.57792 -71.72088
## 174 (273143.3, 4606496)    L1R4 41.57796 -71.72120
## 175 (273133.1, 4606485)    L1R4 41.57786 -71.72132
## 176 (273133.1, 4606483)    L1R4 41.57784 -71.72132
## 177 (273131.4, 4606492)    L1R4 41.57792 -71.72134
## 178 (273130.5, 4606492)    L1R4 41.57792 -71.72135
## 179 (273133.8, 4606486)    L1R4 41.57787 -71.72131
## 180 (273135.6, 4606484)    L1R4 41.57785 -71.72129
## 181 (273132.3, 4606493)    L1R4 41.57793 -71.72133
## 182 (273133.3, 4606490)    L1R4 41.57790 -71.72132
## 183   (273133, 4606492)    L1R4 41.57792 -71.72132
## 184   (273179, 4606465)    L1R4 41.57769 -71.72076
## 185 (273133.3, 4606487)    L1R4 41.57788 -71.72132
## 186 (273130.4, 4606483)    L1R4 41.57784 -71.72135
## 187   (273129, 4606487)    L1R4 41.57788 -71.72137
## 188 (273124.9, 4606490)    L1R4 41.57790 -71.72142
## 189 (273132.4, 4606485)    L1R4 41.57786 -71.72133
## 190 (273139.6, 4606472)    L1R4 41.57775 -71.72124
## 191 (273152.6, 4606474)    L1R4 41.57777 -71.72108
## 192 (273135.1, 4606511)    L1R4 41.57809 -71.72131
## 193 (273139.6, 4606504)    L1R4 41.57803 -71.72125
## 194 (273130.1, 4606506)    L1R4 41.57805 -71.72136
## 195 (273132.3, 4606520)    L1R4 41.57817 -71.72134
## 196 (273119.9, 4606528)    L1R4 41.57825 -71.72149
## 197 (273127.6, 4606511)    L1R4 41.57809 -71.72139
## 198 (273130.3, 4606509)    L1R4 41.57808 -71.72136
## 199 (273127.5, 4606496)    L1R4 41.57795 -71.72139
## 200 (273120.6, 4606498)    L1R4 41.57797 -71.72147
## 201 (273125.5, 4606502)    L1R4 41.57801 -71.72142
## 202 (273138.6, 4606507)    L1R4 41.57805 -71.72126
## 203   (273075, 4606516)    L1R4 41.57812 -71.72203
## 204 (273047.6, 4606528)    L1R4 41.57822 -71.72236
## 205 (273037.8, 4606557)    L1R4 41.57848 -71.72249
## 206 (273034.2, 4606488)    L1R4 41.57785 -71.72251
## 207 (273047.5, 4606459)    L1R4 41.57760 -71.72233
## 208 (273049.4, 4606462)    L1R4 41.57763 -71.72231
## 209   (273135, 4606454)    L1R4 41.57758 -71.72128
## 210 (273149.3, 4606050)    L1R4 41.57395 -71.72096
## 211 (273067.8, 4606429)    L1R4 41.57733 -71.72208
## 212 (273046.1, 4606453)    L1R4 41.57755 -71.72235
## 213 (273043.9, 4606464)    L1R4 41.57765 -71.72238
## 214 (273039.9, 4606444)    L1R4 41.57747 -71.72242
## 215 (273038.7, 4606454)    L1R4 41.57756 -71.72244
## 216   (273039, 4606448)    L1R4 41.57750 -71.72243
## 217 (273033.2, 4606448)    L1R4 41.57750 -71.72250
## 218 (273038.8, 4606449)    L1R4 41.57750 -71.72244
## 219 (273043.2, 4606466)    L1R4 41.57766 -71.72239
## 220 (273207.2, 4606528)    L1R4 41.57826 -71.72045
## 221 (273140.7, 4606561)    L1R4 41.57854 -71.72126
## 222 (273144.4, 4606553)    L1R4 41.57847 -71.72121
```

```
## 223 (273134.4, 4606561)   L1R4 41.57855 -71.72133
## 224 (273128.7, 4606546)   L1R4 41.57841 -71.72139
## 225 (273128.2, 4606558)   L1R4 41.57852 -71.72141
## 226   (273094, 4606565)   L1R4 41.57857 -71.72182
## 227 (272973.6, 4606594)   L1R4 41.57880 -71.72327
## 228 (272981.3, 4606592)   L1R4 41.57878 -71.72318
## 229 (272981.7, 4606577)   L1R4 41.57864 -71.72317
## 230 (272968.4, 4606563)   L1R4 41.57851 -71.72332
## 231 (272961.6, 4606565)   L1R4 41.57853 -71.72340
## 232 (272958.7, 4606528)   L1R4 41.57820 -71.72343
## 233 (272771.2, 4606262)   L1R4 41.57575 -71.72557
## 234 (272755.8, 4606261)   L1R4 41.57573 -71.72575
## 235 (272730.1, 4606302)   L1R4 41.57610 -71.72608
## 236   (272628, 4606193)   L1R4 41.57509 -71.72726
## 237 (272614.6, 4606194)   L1R4 41.57510 -71.72742
## 238 (272568.8, 4606170)   L1R4 41.57486 -71.72796
## 239 (272585.8, 4606133)   L1R4 41.57454 -71.72774
## 240 (272602.9, 4606120)   L1R4 41.57443 -71.72753
## 241 (272609.2, 4606130)   L1R4 41.57452 -71.72746
## 242 (272645.5, 4606145)   L1R4 41.57466 -71.72703
## 243 (272640.7, 4606146)   L1R4 41.57467 -71.72709
## 244 (272709.5, 4606198)   L1R4 41.57516 -71.72629
## 245   (272780, 4606254)   L1R4 41.57568 -71.72546
## 246 (272806.6, 4606304)   L1R4 41.57614 -71.72516
## 247 (272992.7, 4606312)   L1R4 41.57626 -71.72294
## 248 (272990.2, 4606313)   L1R4 41.57627 -71.72297
## 249 (272882.7, 4606302)   L1R4 41.57614 -71.72425
## 250 (272856.1, 4606174)   L1R4 41.57498 -71.72452
## 251 (272852.2, 4606178)   L1R4 41.57502 -71.72457
## 252   (272846, 4606142)   L1R4 41.57469 -71.72463
## 253 (272862.3, 4606126)   L1R4 41.57455 -71.72443
## 254   (272859, 4606134)   L1R4 41.57463 -71.72447
## 255 (272857.9, 4606130)   L1R4 41.57458 -71.72448
## 256 (272858.4, 4606133)   L1R4 41.57461 -71.72448
## 257 (272840.1, 4606125)   L1R4 41.57454 -71.72469
## 258 (272802.7, 4606157)   L1R4 41.57482 -71.72515
## 259 (272852.5, 4606129)   L1R4 41.57458 -71.72455
## 260 (272854.3, 4606138)   L1R4 41.57465 -71.72453
## 261 (272847.1, 4606128)   L1R4 41.57457 -71.72461
## 262 (272864.2, 4606127)   L1R4 41.57456 -71.72441
## 263 (272859.7, 4606134)   L1R4 41.57462 -71.72446
## 264 (272851.8, 4606129)   L1R4 41.57457 -71.72455
## 265 (272859.2, 4606133)   L1R4 41.57462 -71.72447
## 266   (272859, 4606133)   L1R4 41.57462 -71.72447
## 267 (272852.1, 4606136)   L1R4 41.57464 -71.72455
## 268 (272843.7, 4606132)   L1R4 41.57460 -71.72465
## 269 (272842.8, 4606123)   L1R4 41.57452 -71.72466
## 270 (272856.1, 4606133)   L1R4 41.57461 -71.72450
## 271 (272848.8, 4606146)   L1R4 41.57473 -71.72460
## 272 (272846.1, 4606156)   L1R4 41.57482 -71.72463
## 273 (272839.5, 4606162)   L1R4 41.57487 -71.72471
## 274 (272859.8, 4606133)   L1R4 41.57462 -71.72446
## 275 (272856.2, 4606136)   L1R4 41.57464 -71.72451
## 276 (272860.8, 4606120)   L1R4 41.57450 -71.72444
```

```
## 277   (272862, 4606130)     L1R4 41.57458 -71.72443
## 278   (272856, 4606116)     L1R4 41.57446 -71.72450
## 279 (272798.4, 4606156)     L1R4 41.57480 -71.72520
## 280 (272797.3, 4606155)     L1R4 41.57479 -71.72522
## 281 (272793.1, 4606151)     L1R4 41.57476 -71.72527
## 282 (272844.8, 4606204)     L1R4 41.57525 -71.72467
## 283 (272856.1, 4606113)     L1R4 41.57443 -71.72450
## 284 (272854.5, 4606116)     L1R4 41.57446 -71.72452
## 285 (272847.4, 4606117)     L1R4 41.57447 -71.72460
## 286 (272844.8, 4606150)     L1R4 41.57476 -71.72465
## 287 (272852.9, 4606148)     L1R4 41.57475 -71.72455
## 288   (272853, 4606116)     L1R4 41.57446 -71.72454
## 289 (272850.8, 4606120)     L1R4 41.57449 -71.72456
## 290 (272841.8, 4606143)     L1R4 41.57470 -71.72468
## 291 (272845.7, 4606124)     L1R4 41.57453 -71.72463
## 292 (272846.7, 4606132)     L1R4 41.57460 -71.72462
## 293 (272837.2, 4606148)     L1R4 41.57474 -71.72474
## 294 (272851.2, 4606121)     L1R4 41.57450 -71.72456
## 295 (272846.8, 4606115)     L1R4 41.57445 -71.72461
## 296 (272852.3, 4606120)     L1R4 41.57450 -71.72455
## 297 (272848.3, 4606128)     L1R4 41.57457 -71.72460
## 298   (272841, 4606128)     L1R4 41.57456 -71.72468
## 299 (272817.9, 4606130)     L1R4 41.57457 -71.72496
## 300 (272836.4, 4606146)     L1R4 41.57472 -71.72475
## 301 (272834.5, 4606142)     L1R4 41.57469 -71.72477
## 302 (272851.2, 4606117)     L1R4 41.57446 -71.72456
## 303 (272840.4, 4606142)     L1R4 41.57469 -71.72470
## 304 (272840.4, 4606143)     L1R4 41.57470 -71.72470
## 305 (272823.1, 4606152)     L1R4 41.57478 -71.72491
## 306 (272832.5, 4606137)     L1R4 41.57465 -71.72479
## 307 (272828.5, 4606131)     L1R4 41.57459 -71.72483
## 308 (272850.7, 4606121)     L1R4 41.57450 -71.72457
## 309 (272841.8, 4606145)     L1R4 41.57472 -71.72468
## 310 (272838.6, 4606148)     L1R4 41.57474 -71.72472
## 311 (272842.6, 4606132)     L1R4 41.57460 -71.72467
## 312 (272840.4, 4606141)     L1R4 41.57468 -71.72470
## 313 (272840.8, 4606145)     L1R4 41.57472 -71.72469
## 314   (272814, 4606159)     L1R4 41.57484 -71.72502
## 315   (272808, 4606155)     L1R4 41.57480 -71.72509
## 316   (272798, 4606157)     L1R4 41.57482 -71.72521
## 317   (272815, 4606139)     L1R4 41.57465 -71.72500
## 318 (272847.8, 4606124)     L1R4 41.57453 -71.72460
## 319 (272848.3, 4606115)     L1R4 41.57445 -71.72459
## 320 (272840.9, 4606130)     L1R4 41.57458 -71.72469
## 321 (272841.1, 4606142)     L1R4 41.57469 -71.72469
## 322   (272835, 4606142)     L1R4 41.57469 -71.72476
## 323 (272827.8, 4606131)     L1R4 41.57459 -71.72484
## 324 (272807.5, 4606156)     L1R4 41.57480 -71.72510
## 325 (272809.5, 4606150)     L1R4 41.57476 -71.72507
## 326   (272833, 4606192)     L1R4 41.57514 -71.72480
## 327 (272835.3, 4606191)     L1R4 41.57513 -71.72478
## 328 (272839.8, 4606193)     L1R4 41.57514 -71.72472
## 329 (272822.4, 4606193)     L1R4 41.57514 -71.72493
## 330   (272821, 4606202)     L1R4 41.57523 -71.72495
```

11

```
## 331      (272821, 4606198)    L1R4 41.57518 -71.72495
## 332      (272819, 4606202)    L1R4 41.57522 -71.72498
## 333    (272810.4, 4606172)    L1R4 41.57495 -71.72507
## 334      (272796, 4606190)    L1R4 41.57511 -71.72525
## 335    (272792.1, 4606240)    L1R4 41.57556 -71.72531
## 336    (273187.2, 4606551)    L3R1 41.57847 -71.72070
## 337    (273217.2, 4606559)    L3R1 41.57855 -71.72034
## 338    (273186.7, 4606505)    L3R1 41.57805 -71.72068
## 339    (273203.5, 4606596)    L3R1 41.57888 -71.72052
## 340    (273175.6, 4606563)    L3R1 41.57857 -71.72084
## 341    (273169.8, 4606552)    L3R1 41.57847 -71.72090
## 342    (273171.3, 4606553)    L3R1 41.57848 -71.72089
## 343      (273170, 4606552)    L3R1 41.57847 -71.72090
## 344    (273167.3, 4606554)    L3R1 41.57849 -71.72094
## 345    (273171.2, 4606548)    L3R1 41.57843 -71.72089
## 346    (273177.2, 4606550)    L3R1 41.57846 -71.72082
## 347    (273212.6, 4606542)    L3R1 41.57839 -71.72039
## 348    (273203.3, 4606393)    L3R1 41.57705 -71.72044
## 349      (273206, 4606361)    L3R1 41.57677 -71.72040
## 350    (273201.7, 4606606)    L3R1 41.57897 -71.72054
## 351    (273221.2, 4606603)    L3R1 41.57894 -71.72031
## 352    (273253.2, 4606576)    L3R1 41.57871 -71.71991
## 353    (273259.3, 4606584)    L3R1 41.57878 -71.71984
## 354    (273256.3, 4606431)    L3R1 41.57741 -71.71982
## 355    (273256.7, 4606433)    L3R1 41.57743 -71.71982
## 356    (273236.3, 4606531)    L3R1 41.57830 -71.72010
## 357    (273238.6, 4606446)    L3R1 41.57754 -71.72004
## 358    (273212.3, 4606368)    L3R1 41.57683 -71.72033
## 359    (273233.9, 4606397)    L3R1 41.57710 -71.72008
## 360    (273218.2, 4606400)    L3R1 41.57712 -71.72027
## 361    (273233.7, 4606398)    L3R1 41.57711 -71.72008
## 362    (273227.6, 4606524)    L3R1 41.57824 -71.72020
## 363    (273179.9, 4606710)    L3R1 41.57990 -71.72084
## 364    (273176.4, 4606707)    L3R1 41.57987 -71.72088
## 365    (273178.1, 4606699)    L3R1 41.57980 -71.72086
## 366    (273168.9, 4606704)    L3R1 41.57984 -71.72097
## 367    (273171.8, 4606695)    L3R1 41.57976 -71.72093
## 368    (273222.2, 4606557)    L3R1 41.57853 -71.72028
## 369    (273155.1, 4606555)    L3R1 41.57850 -71.72108
## 370    (273170.3, 4606549)    L3R1 41.57845 -71.72090
## 371    (273162.1, 4606556)    L3R1 41.57850 -71.72100
## 372    (273161.8, 4606555)    L3R1 41.57849 -71.72100
## 373    (273158.4, 4606551)    L3R1 41.57846 -71.72104
## 374      (273216, 4606568)    L3R1 41.57863 -71.72036
## 375    (273237.9, 4606570)    L3R1 41.57865 -71.72009
## 376    (273232.1, 4606568)    L3R1 41.57864 -71.72016
## 377    (273237.2, 4606568)    L3R1 41.57863 -71.72010
## 378    (273249.3, 4606562)    L3R1 41.57859 -71.71996
## 379    (273245.3, 4606378)    L3R1 41.57693 -71.71993
## 380    (273209.7, 4606177)    L3R1 41.57511 -71.72029
## 381    (273527.9, 4605431)    L3R1 41.56848 -71.71619
## 382    (273548.2, 4605416)    L3R1 41.56836 -71.71594
## 383    (273537.6, 4605434)    L3R1 41.56852 -71.71608
## 384    (273551.5, 4605420)    L3R1 41.56839 -71.71590
```

```
## 385 (273542.7, 4605423)    L3R1 41.56842 -71.71601
## 386 (273536.4, 4605431)    L3R1 41.56849 -71.71609
## 387 (273526.2, 4605446)    L3R1 41.56862 -71.71622
## 388 (273548.6, 4605428)    L3R1 41.56847 -71.71594
## 389 (273536.1, 4605428)    L3R1 41.56847 -71.71609
## 390 (273539.8, 4605428)    L3R1 41.56846 -71.71605
## 391 (273534.6, 4605431)    L3R1 41.56849 -71.71611
## 392   (273522, 4605532)    L3R1 41.56940 -71.71630
## 393 (273529.1, 4605555)    L3R1 41.56960 -71.71622
## 394 (273514.5, 4605543)    L3R1 41.56949 -71.71639
## 395 (273504.2, 4605524)    L3R1 41.56931 -71.71651
## 396 (273521.9, 4605558)    L3R1 41.56963 -71.71631
## 397 (273532.6, 4605558)    L3R1 41.56963 -71.71618
## 398 (273538.7, 4605559)    L3R1 41.56965 -71.71611
## 399 (273543.6, 4605562)    L3R1 41.56968 -71.71605
## 400 (273498.9, 4605536)    L3R1 41.56942 -71.71658
## 401 (273488.1, 4605554)    L3R1 41.56959 -71.71671
## 402 (273441.1, 4605645)    L3R1 41.57039 -71.71731
## 403 (273438.1, 4605639)    L3R1 41.57033 -71.71734
## 404 (273362.1, 4605616)    L3R1 41.57010 -71.71825
## 405   (273343, 4605634)    L3R1 41.57027 -71.71848
## 406 (273354.2, 4605670)    L3R1 41.57059 -71.71836
## 407 (273347.9, 4605680)    L3R1 41.57068 -71.71844
## 408   (273340, 4605671)    L3R1 41.57059 -71.71853
## 409 (273323.8, 4605660)    L3R1 41.57049 -71.71872
## 410 (273276.5, 4605656)    L3R1 41.57044 -71.71929
## 411   (273293, 4605636)    L3R1 41.57027 -71.71908
## 412 (273196.8, 4606293)    L3R1 41.57615 -71.72048
## 413 (273181.6, 4606432)    L3R1 41.57739 -71.72072
## 414   (273222, 4606565)    L3R1 41.57860 -71.72028
## 415 (273137.5, 4606534)    L3R1 41.57830 -71.72128
## 416 (273136.6, 4606536)    L3R1 41.57832 -71.72130
## 417 (273139.7, 4606538)    L3R1 41.57833 -71.72126
## 418   (273183, 4606634)    L3R1 41.57921 -71.72078
## 419 (273388.5, 4606538)    L3R1 41.57841 -71.71828
## 420 (273424.5, 4606553)    L3R1 41.57856 -71.71785
## 421 (273453.1, 4606570)    L3R1 41.57871 -71.71752
## 422 (273453.1, 4606571)    L3R1 41.57872 -71.71752
## 423 (273439.6, 4606566)    L3R1 41.57867 -71.71768
## 424 (273346.7, 4606550)    L3R1 41.57850 -71.71878
## 425 (273206.3, 4606540)    L3R1 41.57837 -71.72046
## 426   (273199, 4606559)    L3R1 41.57854 -71.72056
## 427 (273140.7, 4606539)    L3R1 41.57835 -71.72125
## 428 (273139.1, 4606540)    L3R1 41.57835 -71.72127
## 429 (273139.4, 4606539)    L3R1 41.57835 -71.72126
## 430 (273129.3, 4606546)    L3R1 41.57841 -71.72139
## 431 (273128.4, 4606544)    L3R1 41.57839 -71.72140
## 432 (273117.8, 4606535)    L3R1 41.57831 -71.72152
## 433 (273119.7, 4606543)    L3R1 41.57838 -71.72150
## 434 (273224.1, 4606545)    L3R1 41.57843 -71.72025
## 435 (273182.5, 4606550)    L3R1 41.57846 -71.72075
## 436 (273183.7, 4606544)    L3R1 41.57841 -71.72073
## 437 (273217.5, 4606576)    L3R1 41.57870 -71.72034
## 438 (273140.5, 4606578)    L3R1 41.57870 -71.72127
```

```
## 439 (273135.8, 4606570)     L3R1 41.57862 -71.72132
## 440 (273134.7, 4606567)     L3R1 41.57860 -71.72133
## 441 (273369.8, 4606478)     L3R1 41.57787 -71.71848
## 442 (273345.9, 4606488)     L3R1 41.57795 -71.71877
## 443 (273408.6, 4606528)     L3R1 41.57833 -71.71803
## 444 (273405.7, 4606530)     L3R1 41.57834 -71.71807
## 445 (273422.6, 4606799)     L3R1 41.58077 -71.71797
## 446 (273477.9, 4606860)     L3R1 41.58133 -71.71733
## 447 (273456.7, 4606904)     L3R1 41.58172 -71.71760
## 448 (273462.3, 4606905)     L3R1 41.58173 -71.71753
## 449 (273444.2, 4606914)     L3R1 41.58181 -71.71775
## 450 (273440.4, 4606885)     L3R1 41.58154 -71.71779
## 451 (273437.6, 4606884)     L3R1 41.58153 -71.71782
## 452 (273399.9, 4606702)     L3R1 41.57988 -71.71820
## 453 (273414.4, 4606524)     L3R1 41.57829 -71.71796
## 454 (273407.8, 4606558)     L3R1 41.57859 -71.71806
## 455 (273407.9, 4606564)     L3R1 41.57864 -71.71806
## 456   (273410, 4606570)     L3R1 41.57870 -71.71803
## 457 (273358.6, 4606482)     L3R1 41.57790 -71.71862
## 458   (273256, 4606470)     L3R1 41.57776 -71.71984
## 459   (273237, 4606454)     L3R1 41.57761 -71.72006
## 460 (273233.7, 4606470)     L3R1 41.57776 -71.72011
## 461   (273317, 4606414)     L3R1 41.57727 -71.71909
## 462 (273332.6, 4606436)     L3R1 41.57748 -71.71891
## 463 (273329.7, 4606439)     L3R1 41.57750 -71.71895
## 464 (273313.3, 4606438)     L3R1 41.57749 -71.71914
## 465 (273343.3, 4606487)     L3R1 41.57794 -71.71880
## 466 (273386.5, 4606473)     L3R1 41.57782 -71.71828
## 467 (273402.6, 4606463)     L3R1 41.57774 -71.71808
## 468 (273439.6, 4606467)     L3R1 41.57778 -71.71764
## 469 (273372.8, 4606572)     L3R1 41.57871 -71.71848
## 470 (273388.6, 4606481)     L3R1 41.57790 -71.71826
## 471 (273335.9, 4606573)     L3R1 41.57871 -71.71892
## 472 (273351.6, 4606569)     L3R1 41.57868 -71.71873
## 473   (273341, 4606568)     L3R1 41.57867 -71.71886
## 474 (273344.5, 4606571)     L3R1 41.57870 -71.71882
## 475 (273342.2, 4606576)     L3R1 41.57874 -71.71885
## 476 (273344.3, 4606565)     L3R1 41.57864 -71.71882
## 477 (273338.7, 4606569)     L3R1 41.57867 -71.71889
## 478 (273334.8, 4606575)     L3R1 41.57872 -71.71894
## 479 (273324.8, 4606572)     L3R1 41.57869 -71.71905
## 480 (273318.9, 4606589)     L3R1 41.57884 -71.71913
## 481 (273326.3, 4606603)     L3R1 41.57897 -71.71905
## 482 (273341.5, 4606554)     L3R1 41.57854 -71.71885
## 483 (273410.2, 4606541)     L3R1 41.57844 -71.71802
## 484 (273432.1, 4606544)     L3R1 41.57847 -71.71776
## 485 (273430.7, 4606528)     L3R1 41.57833 -71.71777
## 486 (273439.6, 4606526)     L3R1 41.57831 -71.71766
## 487 (273440.8, 4606531)     L3R1 41.57836 -71.71765
## 488 (273436.2, 4606528)     L3R1 41.57834 -71.71770
## 489 (273430.5, 4606547)     L3R1 41.57850 -71.71778
## 490 (273328.6, 4606450)     L3R1 41.57760 -71.71896
## 491 (273375.7, 4606509)     L3R1 41.57814 -71.71842
## 492 (273313.6, 4606477)     L3R1 41.57784 -71.71915
```

```
## 493 (273319.7, 4606475)    L3R1 41.57782 -71.71908
## 494 (273320.7, 4606473)    L3R1 41.57781 -71.71907
## 495 (273352.2, 4606484)    L3R1 41.57791 -71.71869
## 496 (273348.3, 4606466)    L3R1 41.57775 -71.71873
## 497 (273357.2, 4606480)    L3R1 41.57788 -71.71863
## 498 (273434.1, 4606551)    L3R1 41.57854 -71.71774
## 499 (273420.4, 4606575)    L3R1 41.57875 -71.71791
## 500 (273433.6, 4606536)    L3R1 41.57840 -71.71774
## 501 (273454.9, 4606534)    L3R1 41.57839 -71.71748
## 502 (273439.2, 4606509)    L3R1 41.57816 -71.71766
## 503 (273442.9, 4606516)    L3R1 41.57822 -71.71762
## 504 (273462.2, 4606519)    L3R1 41.57826 -71.71739
## 505   (273444, 4606505)    L3R1 41.57813 -71.71760
## 506 (273449.6, 4606521)    L3R1 41.57827 -71.71754
## 507 (273432.1, 4606526)    L3R1 41.57831 -71.71775
## 508   (273436, 4606525)    L3R1 41.57830 -71.71770
## 509 (273438.6, 4606535)    L3R1 41.57840 -71.71768
## 510 (273441.4, 4606513)    L3R1 41.57820 -71.71764
## 511 (273441.2, 4606511)    L3R1 41.57818 -71.71764
## 512 (273437.4, 4606510)    L3R1 41.57817 -71.71768
## 513 (273444.1, 4606511)    L3R1 41.57818 -71.71760
## 514 (273418.2, 4606514)    L3R1 41.57820 -71.71791
## 515 (273323.2, 4606440)    L3R1 41.57751 -71.71902
## 516 (273329.7, 4606478)    L3R1 41.57785 -71.71896
## 517   (273315, 4606481)    L3R1 41.57788 -71.71914
## 518 (273313.4, 4606478)    L3R1 41.57784 -71.71916
## 519 (273315.1, 4606473)    L3R1 41.57780 -71.71913
## 520 (273307.8, 4606491)    L3R1 41.57796 -71.71923
## 521 (273331.6, 4606486)    L3R1 41.57793 -71.71894
## 522 (273316.2, 4606472)    L3R1 41.57779 -71.71912
## 523 (273319.7, 4606495)    L3R1 41.57800 -71.71909
## 524 (273476.7, 4606884)    L3R1 41.58155 -71.71735
## 525 (273482.2, 4606931)    L3R1 41.58197 -71.71730
## 526 (273489.8, 4606939)    L3R1 41.58204 -71.71722
## 527 (273485.8, 4606925)    L3R1 41.58192 -71.71726
## 528   (273482, 4606929)    L3R1 41.58195 -71.71731
## 529 (273480.5, 4606932)    L3R1 41.58198 -71.71733
## 530 (273498.6, 4606920)    L3R1 41.58188 -71.71710
## 531 (273507.1, 4606917)    L3R1 41.58185 -71.71700
## 532 (273458.9, 4606881)    L3R1 41.58151 -71.71756
## 533 (273448.9, 4606912)    L3R1 41.58179 -71.71770
## 534 (273452.2, 4606899)    L3R1 41.58168 -71.71765
## 535 (273447.8, 4606898)    L3R1 41.58166 -71.71770
## 536   (273463, 4606886)    L3R1 41.58156 -71.71752
## 537 (273458.1, 4606881)    L3R1 41.58152 -71.71757
## 538 (273463.3, 4606863)    L3R1 41.58136 -71.71750
## 539 (273448.9, 4606899)    L3R1 41.58167 -71.71769
## 540 (273436.5, 4606916)    L3R1 41.58183 -71.71785
## 541   (273439, 4606898)    L3R1 41.58166 -71.71781
## 542 (273427.2, 4606903)    L3R1 41.58170 -71.71795
## 543 (273452.1, 4606854)    L3R1 41.58127 -71.71764
## 544 (273440.9, 4606869)    L3R1 41.58140 -71.71778
## 545 (273455.7, 4606864)    L3R1 41.58136 -71.71760
## 546 (273426.5, 4606865)    L3R1 41.58136 -71.71795
```

```
## 547 (273428.1, 4606862)     L3R1 41.58133 -71.71793
## 548 (273430.5, 4606864)     L3R1 41.58135 -71.71790
## 549   (273423, 4606855)     L3R1 41.58127 -71.71798
## 550 (273423.6, 4606861)     L3R1 41.58133 -71.71798
## 551 (273421.4, 4606877)     L3R1 41.58147 -71.71801
## 552 (273446.1, 4606840)     L3R1 41.58114 -71.71770
## 553 (273441.5, 4606836)     L3R1 41.58111 -71.71776
## 554 (273440.7, 4606846)     L3R1 41.58120 -71.71777
## 555   (273423, 4606835)     L3R1 41.58109 -71.71798
## 556 (273416.9, 4606843)     L3R1 41.58116 -71.71805
## 557 (273437.8, 4606877)     L3R1 41.58147 -71.71782
## 558 (273441.3, 4606864)     L3R1 41.58135 -71.71777
## 559 (273448.2, 4606874)     L3R1 41.58145 -71.71769
## 560 (273451.4, 4606858)     L3R1 41.58130 -71.71765
## 561 (273438.8, 4606875)     L3R1 41.58146 -71.71780
## 562 (273434.6, 4606893)     L3R1 41.58162 -71.71786
## 563   (273434, 4606897)     L3R1 41.58165 -71.71787
## 564   (273422, 4606902)     L3R1 41.58169 -71.71801
## 565 (273444.4, 4606878)     L3R1 41.58148 -71.71774
## 566   (273435, 4606910)     L3R1 41.58177 -71.71786
## 567 (273455.7, 4606894)     L3R1 41.58163 -71.71761
## 568 (273452.9, 4606908)     L3R1 41.58176 -71.71765
## 569 (273443.5, 4606894)     L3R1 41.58163 -71.71775
## 570   (273450, 4606908)     L3R1 41.58176 -71.71768
## 571 (273447.1, 4606895)     L3R1 41.58164 -71.71771
## 572   (273440, 4606913)     L3R1 41.58180 -71.71780
## 573 (273435.4, 4606890)     L3R1 41.58159 -71.71785
## 574 (273444.7, 4606877)     L3R1 41.58148 -71.71773
## 575 (273446.7, 4606870)     L3R1 41.58141 -71.71771
## 576 (273444.4, 4606862)     L3R1 41.58134 -71.71773
## 577 (273466.9, 4606833)     L3R1 41.58109 -71.71745
## 578 (273422.7, 4606845)     L3R1 41.58118 -71.71799
## 579 (273413.8, 4606829)     L3R1 41.58104 -71.71809
## 580 (273402.5, 4606870)     L3R1 41.58140 -71.71824
## 581 (273397.3, 4606841)     L3R1 41.58113 -71.71829
## 582 (273417.8, 4606837)     L3R1 41.58111 -71.71804
## 583 (273411.8, 4606831)     L3R1 41.58105 -71.71811
## 584 (273408.7, 4606832)     L3R1 41.58106 -71.71815
## 585 (273392.1, 4606839)     L3R1 41.58111 -71.71835
## 586 (273409.4, 4606839)     L3R1 41.58112 -71.71814
## 587 (273404.6, 4606829)     L3R1 41.58103 -71.71820
## 588 (273411.8, 4606834)     L3R1 41.58108 -71.71811
## 589 (273410.8, 4606836)     L3R1 41.58110 -71.71812
## 590 (273411.8, 4606832)     L3R1 41.58106 -71.71811
## 591 (273446.7, 4606829)     L3R1 41.58104 -71.71769
## 592 (273210.6, 4606528)     L3R3 41.57827 -71.72041
## 593 (273236.5, 4606527)     L3R3 41.57827 -71.72010
## 594 (273213.3, 4606533)     L3R3 41.57831 -71.72038
## 595 (273227.9, 4606541)     L3R3 41.57839 -71.72020
## 596 (273268.1, 4606530)     L3R3 41.57830 -71.71972
## 597 (273263.3, 4606546)     L3R3 41.57844 -71.71978
## 598 (273264.2, 4606539)     L3R3 41.57838 -71.71977
## 599   (273260, 4606536)     L3R3 41.57835 -71.71982
## 600 (273255.4, 4606553)     L3R3 41.57851 -71.71988
```

16

```
## 601 (273251.4, 4606548)    L3R3 41.57846 -71.71993
## 602   (273249, 4606571)    L3R3 41.57866 -71.71996
## 603 (273254.9, 4606534)    L3R3 41.57834 -71.71988
## 604 (273250.6, 4606541)    L3R3 41.57840 -71.71993
## 605 (273249.9, 4606557)    L3R3 41.57854 -71.71995
## 606 (273250.4, 4606543)    L3R3 41.57841 -71.71994
## 607 (273250.5, 4606542)    L3R3 41.57841 -71.71993
## 608 (273245.4, 4606561)    L3R3 41.57857 -71.72000
## 609 (273257.9, 4606558)    L3R3 41.57855 -71.71985
## 610   (273271, 4606557)    L3R3 41.57855 -71.71969
## 611 (273271.4, 4606564)    L3R3 41.57861 -71.71969
## 612 (273263.3, 4606564)    L3R3 41.57860 -71.71979
## 613 (273279.1, 4606562)    L3R3 41.57859 -71.71960
## 614 (273205.7, 4606497)    L3R3 41.57799 -71.72045
## 615 (273233.8, 4606430)    L3R3 41.57739 -71.72009
## 616 (273208.4, 4606482)    L3R3 41.57786 -71.72042
## 617 (273212.9, 4606492)    L3R3 41.57795 -71.72037
## 618   (273202, 4606482)    L3R3 41.57785 -71.72049
## 619 (273146.2, 4606485)    L3R3 41.57786 -71.72116
## 620 (273147.7, 4606479)    L3R3 41.57781 -71.72114
## 621 (273147.5, 4606471)    L3R3 41.57774 -71.72114
## 622 (273147.2, 4606477)    L3R3 41.57779 -71.72115
## 623 (273146.9, 4606477)    L3R3 41.57779 -71.72115
## 624 (273147.6, 4606474)    L3R3 41.57776 -71.72114
## 625   (273153, 4606473)    L3R3 41.57775 -71.72108
## 626 (273219.9, 4606490)    L3R3 41.57793 -71.72028
## 627 (273225.5, 4606523)    L3R3 41.57823 -71.72023
## 628 (273132.4, 4606552)    L3R3 41.57846 -71.72135
## 629 (273140.9, 4606557)    L3R3 41.57851 -71.72125
## 630 (273134.4, 4606546)    L3R3 41.57841 -71.72133
## 631 (273105.3, 4606552)    L3R3 41.57845 -71.72168
## 632 (273123.9, 4606557)    L3R3 41.57850 -71.72146
## 633 (273123.8, 4606556)    L3R3 41.57850 -71.72146
## 634 (273119.4, 4606569)    L3R3 41.57861 -71.72152
## 635 (273129.9, 4606558)    L3R3 41.57852 -71.72139
## 636 (273125.7, 4606553)    L3R3 41.57847 -71.72143
## 637 (273133.3, 4606557)    L3R3 41.57851 -71.72134
## 638 (273213.6, 4606525)    L3R3 41.57824 -71.72037
## 639 (273120.1, 4606535)    L3R3 41.57831 -71.72149
## 640   (273138, 4606537)    L3R3 41.57832 -71.72128
## 641 (273119.5, 4606522)    L3R3 41.57819 -71.72150
## 642 (273124.2, 4606508)    L3R3 41.57806 -71.72143
## 643 (273126.2, 4606500)    L3R3 41.57800 -71.72141
## 644 (273114.4, 4606512)    L3R3 41.57810 -71.72155
## 645 (273110.7, 4606490)    L3R3 41.57790 -71.72159
## 646 (273120.6, 4606503)    L3R3 41.57802 -71.72148
## 647 (273118.8, 4606499)    L3R3 41.57799 -71.72150
## 648 (273118.4, 4606498)    L3R3 41.57797 -71.72150
## 649 (273122.2, 4606503)    L3R3 41.57802 -71.72146
## 650 (273117.6, 4606507)    L3R3 41.57805 -71.72151
## 651 (273111.5, 4606500)    L3R3 41.57799 -71.72158
## 652 (273218.9, 4606586)    L3R3 41.57880 -71.72033
## 653 (273165.2, 4606558)    L3R3 41.57853 -71.72096
## 654 (273169.6, 4606550)    L3R3 41.57845 -71.72091
```

```
## 655  (273135.9, 4606578)    L3R3 41.57870 -71.72132
## 656  (273128.9, 4606578)    L3R3 41.57870 -71.72140
## 657  (273129.1, 4606576)    L3R3 41.57868 -71.72140
## 658  (273131.8, 4606575)    L3R3 41.57866 -71.72137
## 659  (273130.4, 4606579)    L3R3 41.57870 -71.72139
## 660  (273134.8, 4606575)    L3R3 41.57867 -71.72133
## 661  (273121.3, 4606581)    L3R3 41.57872 -71.72150
## 662  (273125.4, 4606581)    L3R3 41.57872 -71.72145
## 663  (273128.3, 4606583)    L3R3 41.57874 -71.72141
## 664  (273119.8, 4606578)    L3R3 41.57869 -71.72151
## 665  (273216.6, 4606564)    L3R3 41.57860 -71.72035
## 666  (273238.5, 4606564)    L3R3 41.57860 -71.72009
## 667  (273211.5, 4606583)    L3R3 41.57877 -71.72042
## 668  (273137.1, 4606589)    L3R3 41.57879 -71.72131
## 669  (273184.8, 4606570)    L3R3 41.57864 -71.72073
## 670  (273116.9, 4606592)    L3R3 41.57881 -71.72155
## 671  (273134.1, 4606591)    L3R3 41.57881 -71.72135
## 672  (273125.4, 4606578)    L3R3 41.57869 -71.72145
## 673    (273145, 4606593)    L3R3 41.57883 -71.72122
## 674  (273138.2, 4606607)    L3R3 41.57895 -71.72130
## 675  (273135.1, 4606599)    L3R3 41.57889 -71.72134
## 676  (273138.2, 4606595)    L3R3 41.57885 -71.72130
## 677  (273166.9, 4606586)    L3R3 41.57878 -71.72095
## 678  (273134.1, 4606572)    L3R3 41.57864 -71.72134
## 679    (273135, 4606587)    L3R3 41.57878 -71.72133
## 680  (273139.6, 4606576)    L3R3 41.57868 -71.72128
## 681  (273142.5, 4606582)    L3R3 41.57873 -71.72124
## 682  (273125.1, 4606584)    L3R3 41.57875 -71.72145
## 683  (273138.8, 4606595)    L3R3 41.57885 -71.72129
## 684  (273133.2, 4606594)    L3R3 41.57884 -71.72136
## 685  (273138.9, 4606593)    L3R3 41.57884 -71.72129
## 686  (273198.8, 4606554)    L3R3 41.57850 -71.72056
## 687  (273167.8, 4606544)    L3R3 41.57840 -71.72093
## 688  (273170.3, 4606564)    L3R3 41.57858 -71.72090
## 689  (273205.2, 4606591)    L3R3 41.57884 -71.72050
## 690  (273220.9, 4606545)    L3R3 41.57842 -71.72029
## 691    (273254, 4606544)    L3R3 41.57842 -71.71989
## 692  (273213.4, 4606568)    L3R3 41.57863 -71.72039
## 693  (273212.2, 4606564)    L3R3 41.57859 -71.72040
## 694  (273371.7, 4606422)    L3R3 41.57736 -71.71844
## 695  (273369.1, 4606434)    L3R3 41.57746 -71.71847
## 696  (273393.4, 4606420)    L3R3 41.57735 -71.71818
## 697    (273392, 4606428)    L3R3 41.57742 -71.71820
## 698  (273397.8, 4606422)    L3R3 41.57736 -71.71812
## 699  (273339.5, 4606455)    L3R3 41.57765 -71.71883
## 700  (273325.2, 4606432)    L3R3 41.57744 -71.71900
## 701  (273334.3, 4606418)    L3R3 41.57732 -71.71888
## 702  (273368.5, 4606443)    L3R3 41.57755 -71.71848
## 703  (273371.4, 4606440)    L3R3 41.57752 -71.71845
## 704  (273362.9, 4606432)    L3R3 41.57745 -71.71855
## 705  (273370.6, 4606432)    L3R3 41.57745 -71.71845
## 706  (273369.7, 4606437)    L3R3 41.57749 -71.71847
## 707  (273357.8, 4606426)    L3R3 41.57740 -71.71860
## 708    (273377, 4606462)    L3R3 41.57772 -71.71839
```

```
## 709 (273433.8, 4606546)    L3R3 41.57849 -71.71774
## 710 (273439.2, 4606549)    L3R3 41.57852 -71.71768
## 711 (273436.3, 4606538)    L3R3 41.57842 -71.71771
## 712 (273445.8, 4606562)    L3R3 41.57864 -71.71760
## 713 (273444.3, 4606564)    L3R3 41.57866 -71.71762
## 714 (273440.3, 4606566)    L3R3 41.57867 -71.71767
## 715 (273442.5, 4606560)    L3R3 41.57862 -71.71764
## 716 (273447.2, 4606558)    L3R3 41.57861 -71.71758
## 717 (273439.4, 4606562)    L3R3 41.57864 -71.71768
## 718 (273441.7, 4606564)    L3R3 41.57866 -71.71765
## 719   (273412, 4606562)    L3R3 41.57863 -71.71801
## 720 (273307.2, 4606486)    L3R3 41.57792 -71.71923
## 721   (273294, 4606476)    L3R3 41.57783 -71.71939
## 722 (273286.8, 4606481)    L3R3 41.57787 -71.71948
## 723 (273297.7, 4606475)    L3R3 41.57782 -71.71934
## 724 (273345.9, 4606434)    L3R3 41.57746 -71.71875
## 725   (273347, 4606440)    L3R3 41.57751 -71.71874
## 726 (273352.6, 4606428)    L3R3 41.57741 -71.71867
## 727   (273331, 4606426)    L3R3 41.57738 -71.71893
## 728 (273333.1, 4606423)    L3R3 41.57736 -71.71890
## 729 (273365.2, 4606360)    L3R3 41.57680 -71.71849
## 730 (273313.4, 4606356)    L3R3 41.57675 -71.71911
## 731 (273312.3, 4606353)    L3R3 41.57672 -71.71912
## 732   (273306, 4606341)    L3R3 41.57661 -71.71919
## 733 (273311.4, 4606361)    L3R3 41.57680 -71.71914
## 734 (273308.8, 4606358)    L3R3 41.57677 -71.71917
## 735 (273312.7, 4606372)    L3R3 41.57690 -71.71912
## 736 (273321.7, 4606358)    L3R3 41.57677 -71.71901
## 737 (273323.1, 4606354)    L3R3 41.57674 -71.71899
## 738 (273297.1, 4606444)    L3R9 41.57754 -71.71934
## 739 (273211.8, 4606509)    L3R9 41.57810 -71.72039
## 740 (273166.2, 4606543)    L3R9 41.57839 -71.72094
## 741 (273179.6, 4606541)    L3R9 41.57837 -71.72078
## 742 (273167.3, 4606541)    L3R9 41.57837 -71.72093
## 743 (273168.1, 4606540)    L3R9 41.57836 -71.72092
## 744 (273168.2, 4606544)    L3R9 41.57840 -71.72092
## 745   (273166, 4606536)    L3R9 41.57833 -71.72094
## 746 (273172.3, 4606530)    L3R9 41.57828 -71.72087
## 747 (273168.6, 4606546)    L3R9 41.57842 -71.72092
## 748 (273176.1, 4606537)    L3R9 41.57834 -71.72082
## 749 (273175.6, 4606543)    L3R9 41.57840 -71.72083
## 750 (273173.6, 4606540)    L3R9 41.57837 -71.72085
## 751 (273165.3, 4606538)    L3R9 41.57834 -71.72095
## 752 (273168.2, 4606534)    L3R9 41.57831 -71.72092
## 753 (273167.3, 4606552)    L3R9 41.57847 -71.72094
## 754 (273151.4, 4606547)    L3R9 41.57842 -71.72112
## 755 (273177.5, 4606540)    L3R9 41.57837 -71.72081
## 756   (273170, 4606550)    L3R9 41.57846 -71.72090
## 757 (273168.3, 4606550)    L3R9 41.57846 -71.72092
## 758 (273164.4, 4606547)    L3R9 41.57843 -71.72097
## 759 (273169.2, 4606543)    L3R9 41.57839 -71.72091
## 760 (273158.9, 4606546)    L3R9 41.57842 -71.72103
## 761 (273163.9, 4606539)    L3R9 41.57835 -71.72097
## 762 (273167.6, 4606546)    L3R9 41.57842 -71.72093
```

```
## 763   (273168, 4606550)      L3R9 41.57845 -71.72092
## 764 (273166.6, 4606537)      L3R9 41.57834 -71.72094
## 765 (273177.4, 4606529)      L3R9 41.57827 -71.72081
## 766 (273161.5, 4606541)      L3R9 41.57837 -71.72100
## 767 (273167.3, 4606541)      L3R9 41.57838 -71.72093
## 768 (273161.6, 4606536)      L3R9 41.57833 -71.72100
## 769   (273170, 4606559)      L3R9 41.57854 -71.72090
## 770 (273158.4, 4606536)      L3R9 41.57832 -71.72104
## 771   (273171, 4606552)      L3R9 41.57848 -71.72089
## 772 (273171.1, 4606544)      L3R9 41.57840 -71.72089
## 773 (273175.7, 4606542)      L3R9 41.57838 -71.72083
## 774 (273170.8, 4606543)      L3R9 41.57839 -71.72089
## 775 (273170.6, 4606536)      L3R9 41.57833 -71.72089
## 776 (273112.9, 4606542)      L3R9 41.57837 -71.72158
## 777 (273195.4, 4606540)      L3R9 41.57837 -71.72059
## 778 (273111.7, 4606546)      L3R9 41.57840 -71.72160
## 779 (273112.9, 4606546)      L3R9 41.57841 -71.72158
## 780 (273105.4, 4606543)      L3R9 41.57838 -71.72167
## 781 (273105.3, 4606540)      L3R9 41.57834 -71.72167
## 782 (273144.6, 4606527)      L3R9 41.57824 -71.72120
## 783 (273176.1, 4606545)      L3R9 41.57841 -71.72083
## 784   (273169, 4606542)      L3R9 41.57838 -71.72091
## 785 (273168.8, 4606539)      L3R9 41.57836 -71.72091
## 786 (273109.9, 4606541)      L3R9 41.57836 -71.72162
## 787 (273103.1, 4606536)      L3R9 41.57831 -71.72170
## 788 (273105.5, 4606547)      L3R9 41.57841 -71.72167
## 789 (273110.8, 4606549)      L3R9 41.57843 -71.72161
## 790 (273167.9, 4606541)      L3R9 41.57838 -71.72092
## 791 (273168.7, 4606535)      L3R9 41.57832 -71.72091
## 792 (273133.7, 4606548)      L3R9 41.57843 -71.72134
## 793 (273113.6, 4606532)      L3R9 41.57827 -71.72157
## 794 (273106.6, 4606519)      L3R9 41.57816 -71.72165
## 795 (273099.6, 4606535)      L3R9 41.57830 -71.72174
## 796 (273117.2, 4606535)      L3R9 41.57830 -71.72153
## 797 (273110.3, 4606533)      L3R9 41.57829 -71.72161
## 798 (273115.9, 4606525)      L3R9 41.57821 -71.72154
## 799 (273117.5, 4606529)      L3R9 41.57825 -71.72152
## 800 (273113.1, 4606521)      L3R9 41.57817 -71.72157
## 801 (273112.7, 4606529)      L3R9 41.57825 -71.72158
## 802 (273229.1, 4606527)      L3R9 41.57826 -71.72018
## 803 (273198.2, 4606531)      L3R9 41.57829 -71.72056
## 804 (273172.1, 4606545)      L3R9 41.57841 -71.72087
## 805 (273169.4, 4606540)      L3R9 41.57836 -71.72090
## 806 (273125.3, 4606544)      L3R9 41.57839 -71.72144
## 807 (273117.6, 4606545)      L3R9 41.57840 -71.72153
## 808 (273115.3, 4606547)      L3R9 41.57842 -71.72156
## 809 (273121.8, 4606530)      L3R9 41.57826 -71.72147
## 810 (273114.4, 4606515)      L3R9 41.57812 -71.72155
## 811 (273119.8, 4606521)      L3R9 41.57818 -71.72149
## 812 (273112.4, 4606530)      L3R9 41.57826 -71.72158
## 813 (273146.3, 4606539)      L3R9 41.57835 -71.72118
## 814 (273185.2, 4606563)      L3R9 41.57857 -71.72072
## 815   (273169, 4606534)      L3R9 41.57831 -71.72091
## 816 (273176.9, 4606539)      L3R9 41.57835 -71.72081
```

```
## 817   (273165.8, 4606540)     L3R9 41.57836 -71.72095
## 818   (273165.7, 4606535)     L3R9 41.57831 -71.72095
## 819   (273170.9, 4606540)     L3R9 41.57836 -71.72089
## 820   (273140.7, 4606544)     L3R9 41.57839 -71.72125
## 821   (273139.7, 4606536)     L3R9 41.57832 -71.72126
## 822   (273139.9, 4606539)     L3R9 41.57835 -71.72126
## 823   (273156.4, 4606541)     L3R9 41.57837 -71.72106
## 824   (273183.6, 4606538)     L3R9 41.57835 -71.72073
## 825   (273159.2, 4606548)     L3R9 41.57843 -71.72103
## 826   (273144.8, 4606542)     L3R9 41.57837 -71.72120
## 827   (273140.1, 4606538)     L3R9 41.57834 -71.72125
## 828   (273139.6, 4606543)     L3R9 41.57838 -71.72126
## 829   (273144.6, 4606542)     L3R9 41.57837 -71.72120
## 830   (273141.2, 4606538)     L3R9 41.57834 -71.72124
## 831   (273209.3, 4606533)     L3R9 41.57832 -71.72042
## 832   (273170.6, 4606548)     L3R9 41.57844 -71.72089
## 833   (273121.6, 4606540)     L3R9 41.57835 -71.72148
## 834   (273132.3, 4606539)     L3R9 41.57835 -71.72135
## 835   (273143.9, 4606542)     L3R9 41.57838 -71.72121
## 836   (273138.2, 4606553)     L3R9 41.57847 -71.72128
## 837   (273141.1, 4606606)     L3R9 41.57895 -71.72127
## 838   (273142.4, 4606605)     L3R9 41.57894 -71.72125
## 839   (273134.2, 4606592)     L3R9 41.57882 -71.72135
## 840   (273125.6, 4606618)     L3R9 41.57905 -71.72146
## 841   (273130.9, 4606615)     L3R9 41.57903 -71.72139
## 842   (273130.2, 4606621)     L3R9 41.57908 -71.72141
## 843   (273134.3, 4606611)     L3R9 41.57899 -71.72135
## 844   (273129.6, 4606610)     L3R9 41.57898 -71.72141
## 845   (273133.9, 4606616)     L3R9 41.57904 -71.72136
## 846   (273130.8, 4606610)     L3R9 41.57898 -71.72139
## 847   (273130.8, 4606596)     L3R9 41.57886 -71.72139
## 848   (273146.5, 4606479)     L3R9 41.57781 -71.72116
## 849   (273145.8, 4606487)     L3R9 41.57788 -71.72117
## 850   (273148.1, 4606485)     L3R9 41.57787 -71.72114
## 851   (273125.9, 4606498)     L3R9 41.57798 -71.72141
## 852   (273120.1, 4606511)     L3R9 41.57809 -71.72148
## 853   (273120.1, 4606516)     L3R9 41.57813 -71.72149
## 854   (273115.7, 4606529)     L3R9 41.57825 -71.72154
## 855   (273236.1, 4606445)     L3R9 41.57753 -71.72007
## 856   (273231.7, 4606459)     L3R9 41.57765 -71.72013
## 857   (273236.7, 4606451)     L3R9 41.57758 -71.72007
## 858   (273210.8, 4606437)     L3R9 41.57745 -71.72037
## 859   (273234.5, 4606448)     L3R9 41.57755 -71.72009
## 860   (273227.4, 4606449)     L3R9 41.57756 -71.72018
## 861     (273229, 4606443)     L3R9 41.57751 -71.72015
## 862   (273236.6, 4606450)     L3R9 41.57758 -71.72007
## 863   (273237.9, 4606449)     L3R9 41.57756 -71.72005
## 864   (273022.1, 4606336)     L3R9 41.57648 -71.72259
## 865   (273017.5, 4606321)     L3R9 41.57635 -71.72264
## 866   (273014.3, 4606319)     L3R9 41.57633 -71.72268
## 867   (273014.3, 4606323)     L3R9 41.57637 -71.72268
## 868   (272967.7, 4606411)     L3R9 41.57715 -71.72327
## 869   (272853.1, 4606400)     L3R9 41.57702 -71.72464
## 870   (272853.2, 4606383)     L3R9 41.57686 -71.72463
```

```
## 871 (272861.1, 4606363)    L3R9 41.57668 -71.72453
## 872 (272874.7, 4606369)    L3R9 41.57674 -71.72437
## 873 (272872.1, 4606359)    L3R9 41.57665 -71.72440
## 874 (272952.7, 4606375)    L3R9 41.57681 -71.72344
## 875 (272965.5, 4606329)    L3R9 41.57641 -71.72327
## 876 (272961.6, 4606337)    L3R9 41.57648 -71.72332
## 877 (272935.2, 4606390)    L3R9 41.57695 -71.72365
## 878 (272964.2, 4606403)    L3R9 41.57708 -71.72331
## 879 (272967.2, 4606402)    L3R9 41.57707 -71.72328
## 880 (272984.5, 4606401)    L3R9 41.57706 -71.72307
## 881 (272989.5, 4606391)    L3R9 41.57697 -71.72300
## 882 (272984.8, 4606395)    L3R9 41.57701 -71.72306
## 883 (272984.2, 4606388)    L3R9 41.57694 -71.72307
## 884 (272991.4, 4606401)    L3R9 41.57706 -71.72299
## 885 (273017.9, 4606325)    L3R9 41.57638 -71.72264
## 886 (273019.7, 4606295)    L3R9 41.57612 -71.72261
## 887   (273012, 4606289)    L3R9 41.57606 -71.72270
## 888 (272933.6, 4606331)    L3R9 41.57642 -71.72365
## 889 (272898.5, 4606444)    L3R9 41.57743 -71.72412
## 890 (272910.5, 4606437)    L3R9 41.57736 -71.72397
## 891   (273019, 4606333)    L3R9 41.57646 -71.72263
## 892 (273025.8, 4606324)    L3R9 41.57638 -71.72254
## 893 (273022.4, 4606312)    L3R9 41.57627 -71.72258
## 894 (273011.6, 4606411)    L3R9 41.57716 -71.72275
## 895 (273332.7, 4606465)    L3R9 41.57773 -71.71892
## 896 (273379.6, 4606521)    L3R9 41.57825 -71.71838
## 897   (273393, 4606517)    L3R9 41.57822 -71.71822
## 898 (273388.8, 4606521)    L3R9 41.57826 -71.71827
## 899 (273384.5, 4606524)    L3R9 41.57828 -71.71832
## 900 (273381.3, 4606518)    L3R9 41.57822 -71.71836
## 901 (273386.9, 4606526)    L3R9 41.57830 -71.71829
## 902 (273381.5, 4606516)    L3R9 41.57821 -71.71835
## 903 (273402.1, 4606526)    L3R9 41.57831 -71.71811
## 904 (273387.1, 4606514)    L3R9 41.57820 -71.71829
## 905 (273384.6, 4606518)    L3R9 41.57822 -71.71832
## 906 (273379.1, 4606519)    L3R9 41.57823 -71.71838
## 907 (273387.2, 4606514)    L3R9 41.57819 -71.71829
## 908   (273388, 4606522)    L3R9 41.57827 -71.71828
## 909 (273389.6, 4606520)    L3R9 41.57825 -71.71826
## 910 (273375.6, 4606504)    L3R9 41.57810 -71.71842
## 911 (272874.2, 4606440)    L3R9 41.57738 -71.72440
## 912 (272877.3, 4606415)    L3R9 41.57716 -71.72436
## 913 (272940.3, 4606361)    L3R9 41.57669 -71.72358
## 914 (272943.7, 4606365)    L3R9 41.57673 -71.72354
## 915 (272941.5, 4606370)    L3R9 41.57677 -71.72357
## 916 (272414.7, 4607417)    L9R0 41.58604 -71.73028
## 917 (272383.5, 4607419)    L9R0 41.58605 -71.73066
## 918 (272393.6, 4607414)    L9R0 41.58601 -71.73053
## 919 (272401.6, 4607405)    L9R0 41.58593 -71.73043
## 920 (272381.5, 4607411)    L9R0 41.58598 -71.73068
## 921 (272388.4, 4607407)    L9R0 41.58594 -71.73059
## 922 (272416.1, 4607415)    L9R0 41.58602 -71.73026
## 923 (272419.4, 4607387)    L9R0 41.58577 -71.73021
## 924 (272420.6, 4607403)    L9R0 41.58592 -71.73020
```

```
## 925 (272438.6, 4607383)    L9R0 41.58574 -71.72998
## 926 (272434.4, 4607364)    L9R0 41.58557 -71.73002
## 927 (272459.7, 4607343)    L9R0 41.58539 -71.72971
## 928 (272432.7, 4607340)    L9R0 41.58536 -71.73004
## 929 (272439.6, 4607383)    L9R0 41.58574 -71.72997
## 930 (272450.4, 4607342)    L9R0 41.58538 -71.72982
## 931 (272385.3, 4607410)    L9R0 41.58597 -71.73063
## 932 (272420.9, 4607390)    L9R0 41.58580 -71.73020
## 933   (272443, 4607374)    L9R0 41.58567 -71.72993
## 934 (272432.1, 4607371)    L9R0 41.58563 -71.73005
## 935   (272123, 4607706)    L9R0 41.58855 -71.73389
## 936 (272120.2, 4607707)    L9R0 41.58857 -71.73392
## 937 (272418.4, 4607424)    L9R0 41.58610 -71.73024
## 938 (272387.3, 4607399)    L9R0 41.58587 -71.73060
## 939 (272394.6, 4607440)    L9R0 41.58625 -71.73053
## 940 (272461.8, 4607322)    L9R0 41.58520 -71.72968
## 941 (272385.3, 4607489)    L9R0 41.58668 -71.73066
## 942 (272390.6, 4607480)    L9R0 41.58660 -71.73059
## 943 (272388.6, 4607432)    L9R0 41.58617 -71.73060
## 944 (272442.8, 4607337)    L9R0 41.58532 -71.72991
## 945 (272392.7, 4607438)    L9R0 41.58622 -71.73055
## 946 (272403.3, 4607412)    L9R0 41.58599 -71.73041
## 947 (272071.8, 4607569)    L9R0 41.58731 -71.73445
## 948 (272054.5, 4607607)    L9R0 41.58765 -71.73467
## 949 (272075.1, 4607601)    L9R0 41.58760 -71.73442
## 950 (272080.6, 4607603)    L9R0 41.58761 -71.73436
## 951 (272070.2, 4607619)    L9R0 41.58776 -71.73449
## 952 (272057.3, 4607579)    L9R0 41.58740 -71.73463
## 953 (272067.9, 4607575)    L9R0 41.58737 -71.73450
## 954 (272074.9, 4607599)    L9R0 41.58758 -71.73442
## 955 (272063.5, 4607602)    L9R0 41.58761 -71.73456
## 956 (272047.3, 4607586)    L9R0 41.58746 -71.73475
## 957 (272063.5, 4607601)    L9R0 41.58759 -71.73456
## 958 (272056.4, 4607594)    L9R0 41.58753 -71.73464
## 959 (272065.7, 4607593)    L9R0 41.58753 -71.73453
## 960 (272077.7, 4607601)    L9R0 41.58760 -71.73439
## 961 (272143.5, 4607714)    L9R0 41.58864 -71.73364
## 962 (272095.5, 4607686)    L9R0 41.58837 -71.73421
## 963 (272082.8, 4607672)    L9R0 41.58824 -71.73435
## 964 (272117.2, 4607702)    L9R0 41.58852 -71.73395
## 965 (272112.1, 4607692)    L9R0 41.58843 -71.73401
## 966 (272107.7, 4607702)    L9R0 41.58851 -71.73407
## 967 (272117.7, 4607697)    L9R0 41.58848 -71.73395
## 968 (272430.1, 4607345)    L9R0 41.58539 -71.73007
## 969 (272676.4, 4607111)    L9R0 41.58336 -71.72703
## 970 (272665.6, 4607090)    L9R0 41.58317 -71.72715
## 971 (272661.8, 4607080)    L9R0 41.58308 -71.72719
## 972 (272616.6, 4607151)    L9R0 41.58371 -71.72776
## 973 (272614.6, 4607182)    L9R0 41.58398 -71.72780
## 974 (272622.1, 4607181)    L9R0 41.58397 -71.72771
## 975 (272607.4, 4607220)    L9R0 41.58433 -71.72790
## 976 (272605.6, 4607223)    L9R0 41.58435 -71.72792
## 977 (272606.9, 4607212)    L9R0 41.58425 -71.72790
## 978 (272598.1, 4607213)    L9R0 41.58426 -71.72801
```

```
## 979  (272597.1, 4607218)       L9R0 41.58430 -71.72802
## 980  (272596.5, 4607223)       L9R0 41.58434 -71.72803
## 981  (272598.9, 4607206)       L9R0 41.58420 -71.72799
## 982  (272596.2, 4607215)       L9R0 41.58427 -71.72803
## 983  (272596.9, 4607228)       L9R0 41.58440 -71.72803
## 984  (272288.9, 4607630)       L9R0 41.58792 -71.73187
## 985  (272291.9, 4607631)       L9R0 41.58793 -71.73183
## 986  (272293.2, 4607624)       L9R0 41.58787 -71.73182
## 987  (271998.5, 4607651)       L9R0 41.58802 -71.73536
## 988  (272045.5, 4607578)       L9R0 41.58738 -71.73477
## 989  (272068.8, 4607585)       L9R0 41.58745 -71.73449
## 990    (272047, 4607596)       L9R0 41.58755 -71.73476
## 991    (272065, 4607554)       L9R0 41.58717 -71.73452
## 992  (272062.3, 4607585)       L9R0 41.58745 -71.73457
## 993    (272058, 4607598)       L9R0 41.58757 -71.73462
## 994  (272074.7, 4607540)       L9R0 41.58705 -71.73440
## 995  (272072.8, 4607531)       L9R0 41.58697 -71.73442
## 996    (272054, 4607544)       L9R0 41.58708 -71.73465
## 997  (272071.9, 4607521)       L9R0 41.58688 -71.73443
## 998  (272065.8, 4607516)       L9R0 41.58683 -71.73450
## 999  (272072.5, 4607521)       L9R0 41.58687 -71.73442
## 1000 (272055.9, 4607499)       L9R0 41.58667 -71.73461
## 1001   (272060, 4607501)       L9R0 41.58670 -71.73456
## 1002 (272022.7, 4607479)       L9R0 41.58649 -71.73500
## 1003 (272029.3, 4607491)       L9R0 41.58660 -71.73493
## 1004 (272032.2, 4607484)       L9R0 41.58653 -71.73489
## 1005 (272024.3, 4607468)       L9R0 41.58638 -71.73498
## 1006 (272030.7, 4607477)       L9R0 41.58647 -71.73490
## 1007 (272029.1, 4607484)       L9R0 41.58653 -71.73493
## 1008 (272025.4, 4607488)       L9R0 41.58657 -71.73497
## 1009 (272023.7, 4607486)       L9R0 41.58655 -71.73499
## 1010 (272027.9, 4607475)       L9R0 41.58645 -71.73494
## 1011 (272026.1, 4607488)       L9R0 41.58657 -71.73496
## 1012 (272027.8, 4607487)       L9R0 41.58656 -71.73494
## 1013 (272033.3, 4607504)       L9R0 41.58672 -71.73488
## 1014 (272400.9, 4607448)       L9R0 41.58631 -71.73046
## 1015 (272451.8, 4607326)       L9R0 41.58523 -71.72980
## 1016 (272449.7, 4607323)       L9R0 41.58521 -71.72983
## 1017 (272451.7, 4607322)       L9R0 41.58520 -71.72980
## 1018 (272448.2, 4607325)       L9R0 41.58522 -71.72984
## 1019 (272450.9, 4607329)       L9R0 41.58526 -71.72981
## 1020 (272449.7, 4607323)       L9R0 41.58520 -71.72982
## 1021 (272450.3, 4607338)       L9R0 41.58534 -71.72982
## 1022 (272452.2, 4607334)       L9R0 41.58530 -71.72980
## 1023 (272446.2, 4607327)       L9R0 41.58524 -71.72987
```

Calculate the MCPs

```
turtles_mcp <- mcp(utm_sp, percent = 100)
```

```
## Warning in proj4string(xy): CRS object has comment, which is lost in output
```

```
## Warning in mcp(utm_sp, percent = 100): xy should contain only one column (the id
## of the animals), id ignored
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
```

```
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition
```
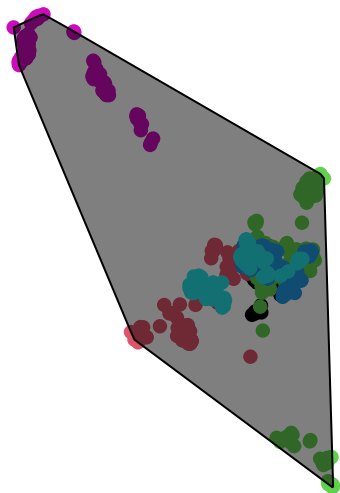
```
turtles_mcp
```

```
## Object of class "SpatialPolygonsDataFrame" (package sp):
##
## Number of SpatialPolygons:  1
##
## Variables measured:
##   id      area
## a  a 178.5572
```

There are 6 SpatialPolygons and 6 turtles so everything looks good.

Plot the MCPs

```
library(scales) #makes polygons transparent
```

```
##
## Attaching package: 'scales'
```

```
## The following object is masked from 'package:purrr':
##
##     discard
```

```
## The following object is masked from 'package:readr':
##
##     col_factor
```

```
plot(utm_sp, col = as.factor(utm_sp@data$Turtle_ID), pch = 16)
plot(turtles_mcp, col = alpha(1:30, 0.5), add = TRUE)
```

Calculate the MCP areas

```
areas <- mcp.area(utm_sp, percent = seq(50, 100, by = 5))
```

```
## Warning in proj4string(xy): CRS object has comment, which is lost in output
```

```
## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition
```

```
## Warning in proj4string(xy): CRS object has comment, which is lost in output
```

```
## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition
```

```
## Warning in proj4string(xy): CRS object has comment, which is lost in output
```

```
## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition
```
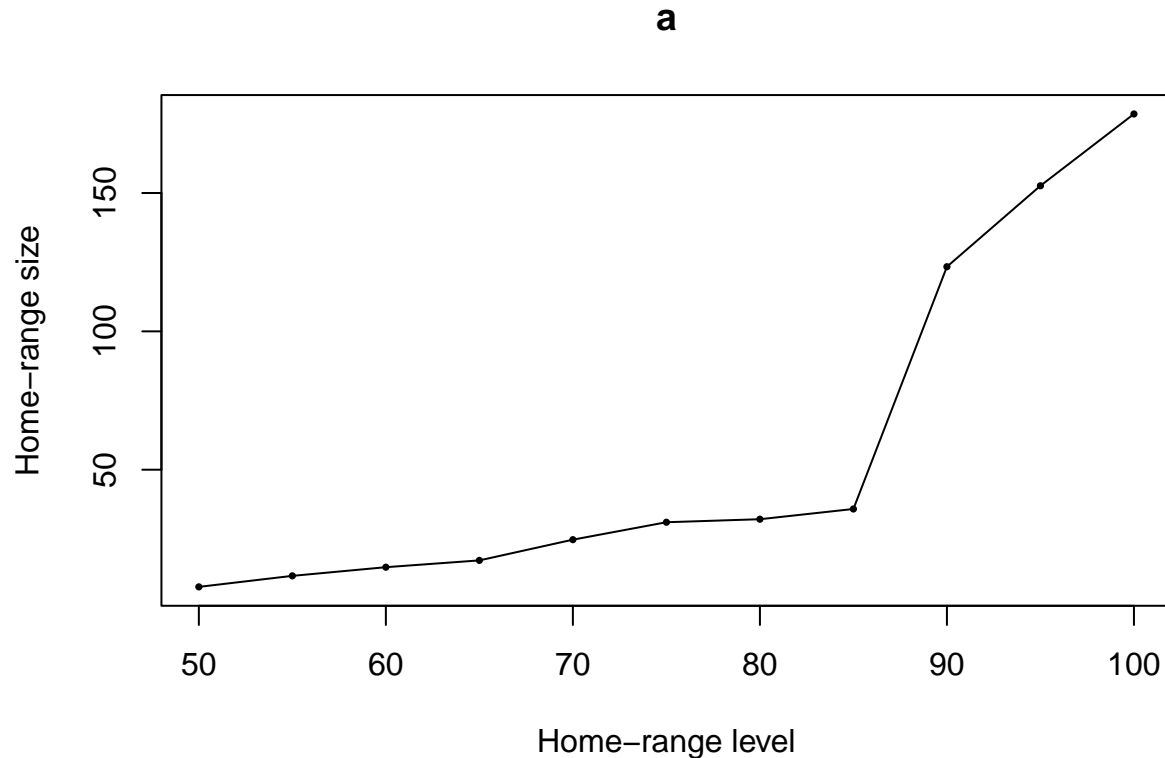
```
## Warning in proj4string(xy): CRS object has comment, which is lost in output

## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition

## Warning in proj4string(xy): CRS object has comment, which is lost in output

## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition

## Warning in proj4string(xy): CRS object has comment, which is lost in output

## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition

## Warning in proj4string(xy): CRS object has comment, which is lost in output

## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition

## Warning in proj4string(xy): CRS object has comment, which is lost in output

## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition

## Warning in proj4string(xy): CRS object has comment, which is lost in output

## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition

## Warning in proj4string(xy): CRS object has comment, which is lost in output

## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition

## Warning in proj4string(xy): CRS object has comment, which is lost in output
```

```
## Warning in mcp(xy, percent = x, unin, unout): xy should contain only one column
## (the id of the animals), id ignored

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO", prefer_proj
## = prefer_proj): Discarded datum Unknown based on WGS84 ellipsoid in Proj4
## definition
```

a


```
areas
```

```
##               a
## 50    7.661185
## 55   11.642051
## 60   14.770089
## 65   17.226348
## 70   24.716694
## 75   31.019158
## 80   32.110700
## 85   35.804645
## 90  123.358226
## 95  152.613135
## 100 178.557241
```

Export the areas file as a .csv for analysis

```
write.csv(areas, here("Data", "turtle_areas.csv"))
```

```
write.csv(turtles_mcp, here("Data", "turtles_mcp.csv"))
```

```r
write.csv(utm_sp, here("Data", "utm_sp.csv"))
```