Flood Presentation 2014

J. Thaddeus Eldredge, PLS

Thadd

www.ese-llc.com/technical/

Password: Surveyor

Perilous waterfront

during a storm can become truly dangerous

to the fearful point of endangerment

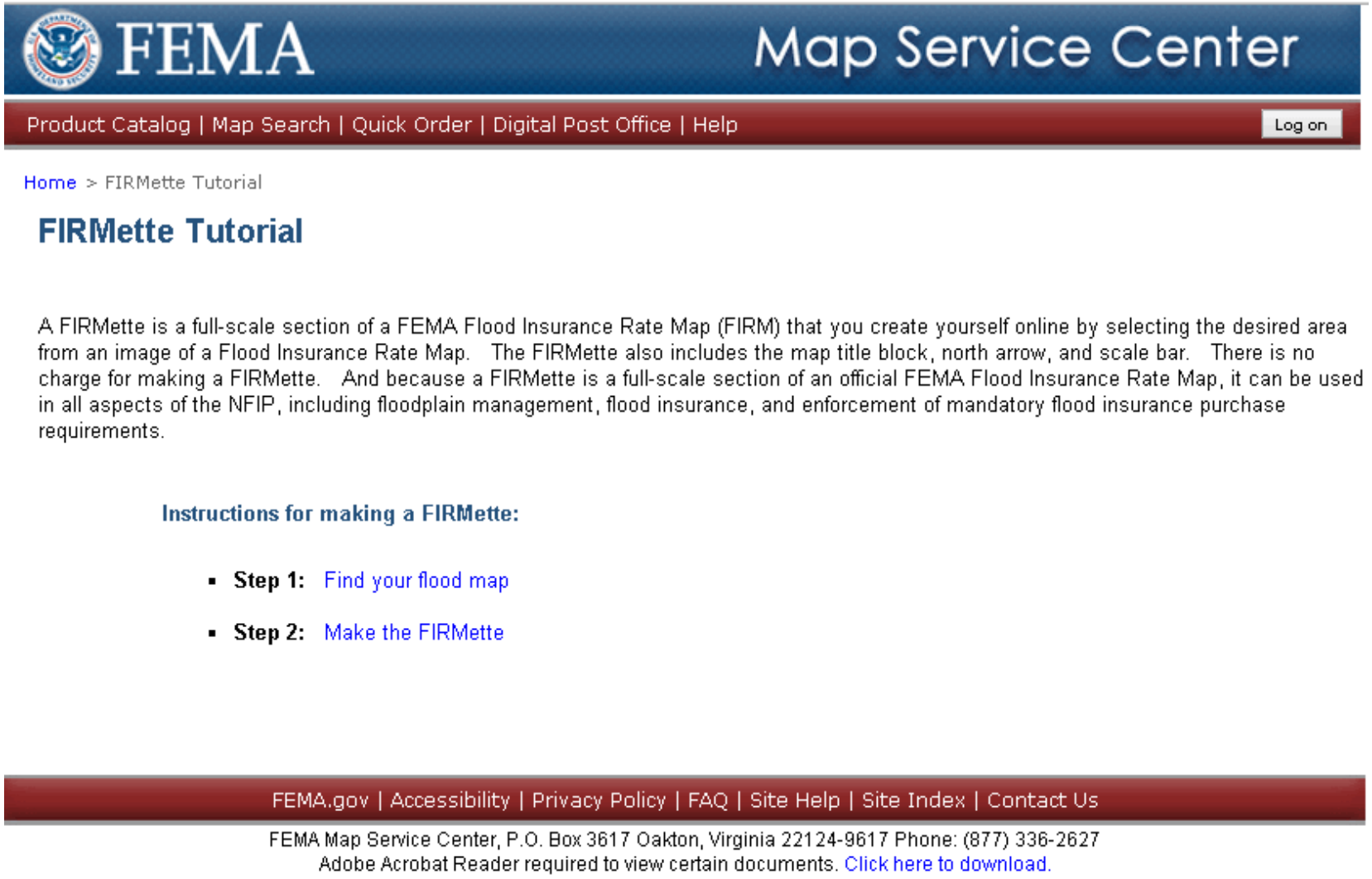
and unfortunate (inevitable) loss.

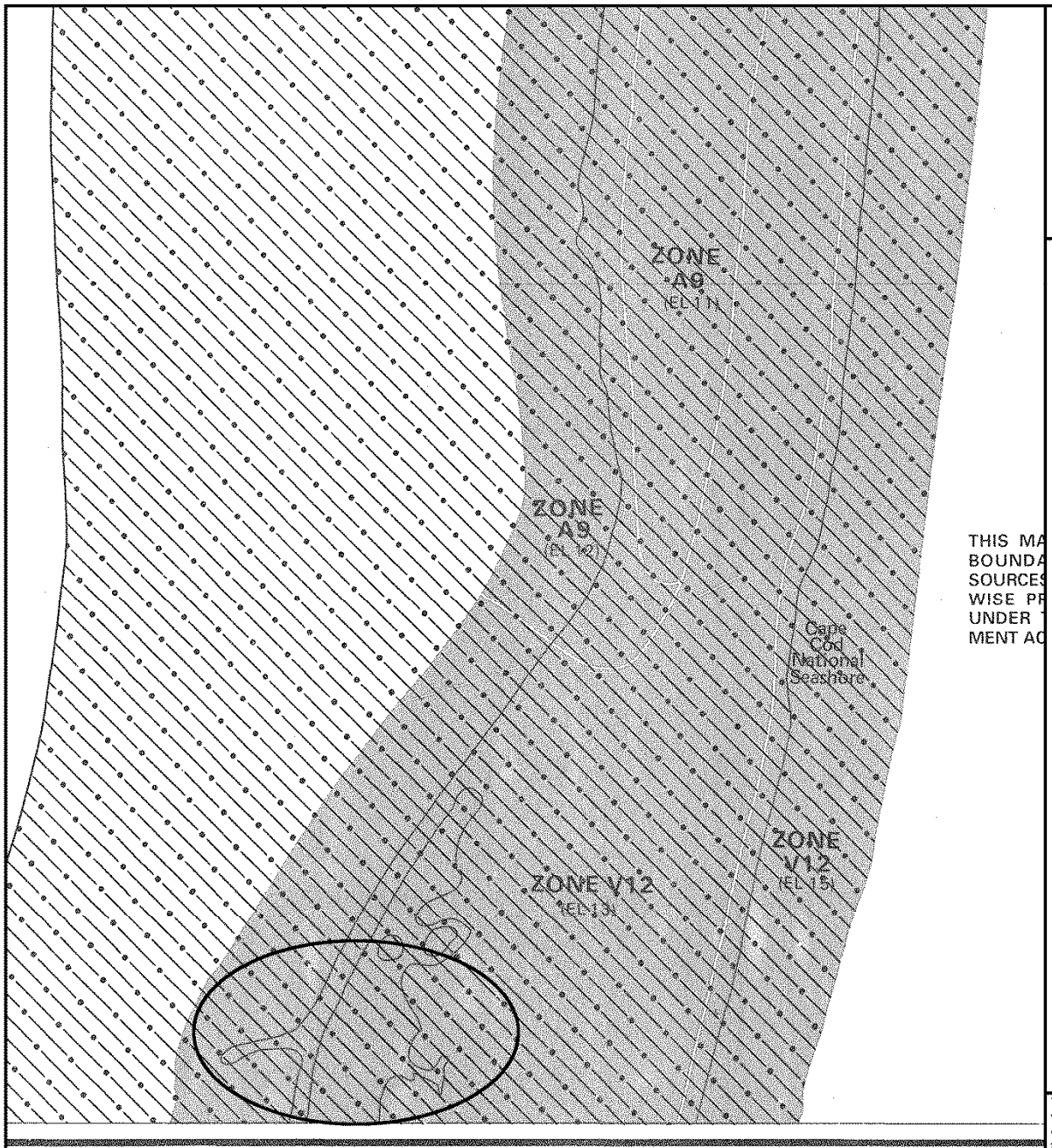
RESEARCH is the most important aspect of every project.

Research is getting easier.

FEMA Map Service Center

FIRMettes are quick and simple…
and there is a tutorial…





THIS MA
BOUNDA
SOURCES
WISE PR
UNDER
MENT AC

APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

TOWN OF
CHATHAM,
MASSACHUSETTS
BARNSTABLE COUNTY

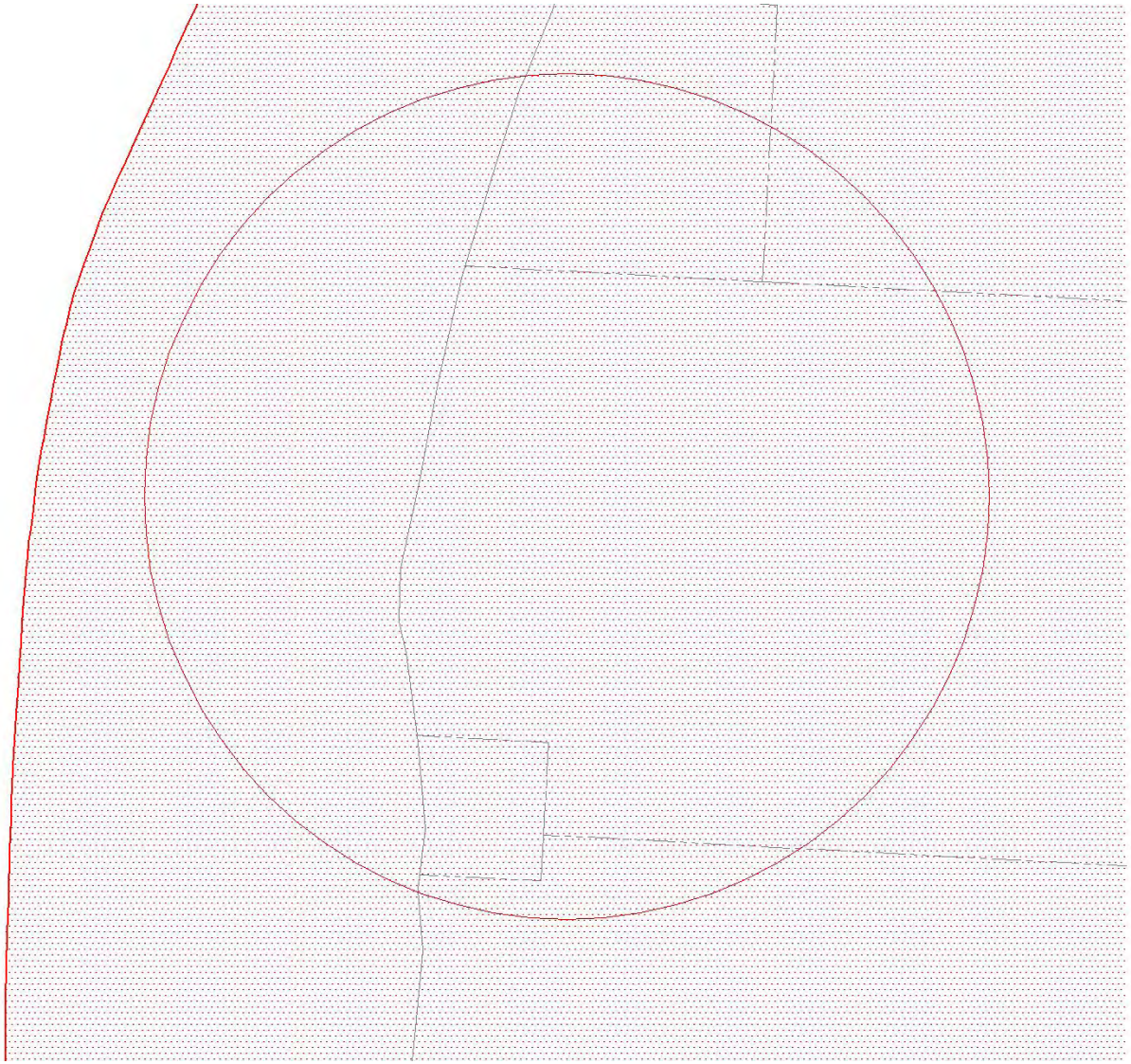
PANEL 4 OF 9
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
250004 0004 D

MAP REVISED:
JANUARY 16, 1992

Federal Emergency Management Agency

GIS Q3



MassGIS Data - FEMA Q3 Flood Zones from Paper FIRMs

July 1997

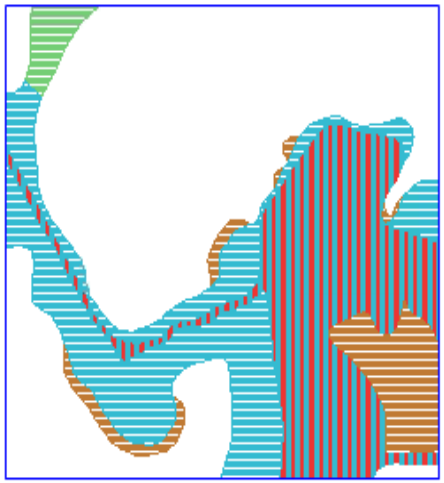
Download this layer (66 MB)
(Shapefiles with ArcGIS 10.0 layer files and FEMA-produced metadata)

IMPORTANT NOTE: IT IS NOT APPROPRIATE TO USE THIS DATALAYER FOR LARGE-SCALE (DETAILED, E.G. PARCEL LEVEL) MAPPING AND ANALYSIS. PLEASE READ ALL DOCUMENTATION PROVIDED BY FEMA TO ENSURE YOU UNDERSTAND THE PROPER USE OF THESE DATA.

Many parts of the state are now updated using DFIRM data. See the FEMA National Flood Hazard Layer page for details.

Overview

These data represent a subset of the data available on the paper Flood Insurance Rate Maps (FIRM) as provided by the Federal Emergency Management Agency (FEMA). The Q3 flood data were developed to support floodplain management and planning activities but do not replace the official paper FIRMs. These data are not suitable for engineering applications or site work nor can the data be used to determine absolute delineation of flood boundaries. Instead the data should be used to portray zones of uncertainty and possible risks associated with flooding. **All counties except Franklin are available for Massachusetts.**



Click to see the full size image.

In ArcSDE the layer is named **Q3FLOOD_POLY**.

A subset of this layer, created by MassGIS in October 2013 and named **Q3FLOOD_POLY_NO_NFHL**, includes data only for areas for which the newer National Flood Hazard Layer are not available. This allows one to

MassGIS Datalayers

Online Mapping

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About MassGIS

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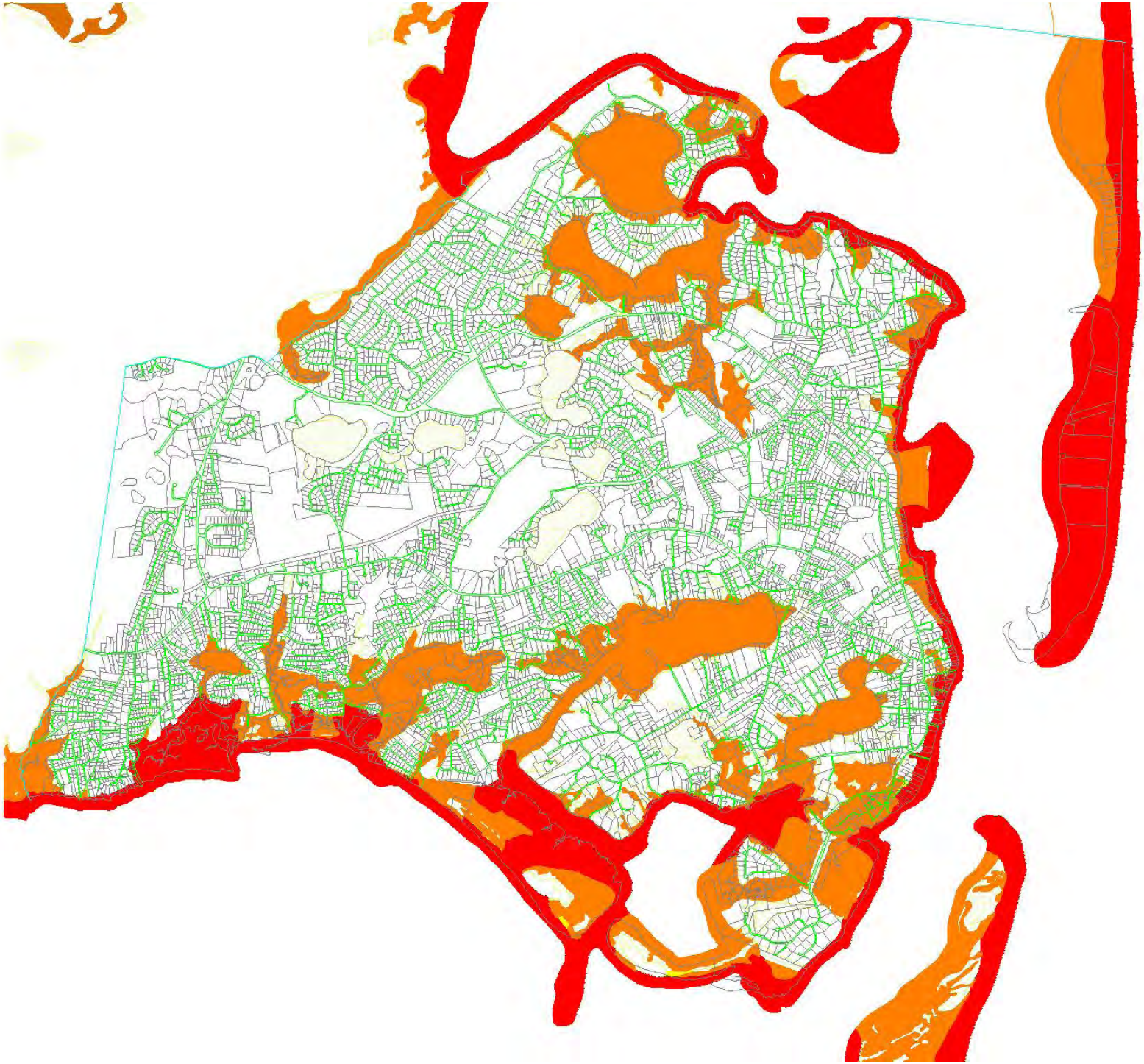
GIS Resources

Standards

Contact MassGIS
(617) 619-5611
paul.nutting@state.ma.us
MassGIS Property Tax Information



THE OLD MAPS AND GIS Q3

- The old maps were very good for when they were created. They are poor compared to today's standards.

- The GIS Q3 layer was digitized from the maps. The digitization does not always match the paper maps and the paper maps do not always match the ground conditions.

- In many locations, the ground has changed since the old maps were created.

Subsidence – Uplift – Erosion – Accretion – Avulsion

MAP SCALE 1" = 500'

250 0 500 1000 FEET

0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0633J

FIRM

FLOOD INSURANCE RATE MAP

BARNSTABLE COUNTY, MASSACHUSETTS (ALL JURISDICTIONS)

PANEL 633 OF 875

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CHATHAM, TOWN OF	250004	0633	J

-NOTE-

THIS MAP INCLUDES BOUNDARIES OF THE COASTAL BARRIER RESOURCES SYSTEM ESTABLISHED UNDER THE COASTAL BARRIER RESOURCES ACT OF 1982 AND/OR SUBSEQUENT ENABLING LEGISLATION.

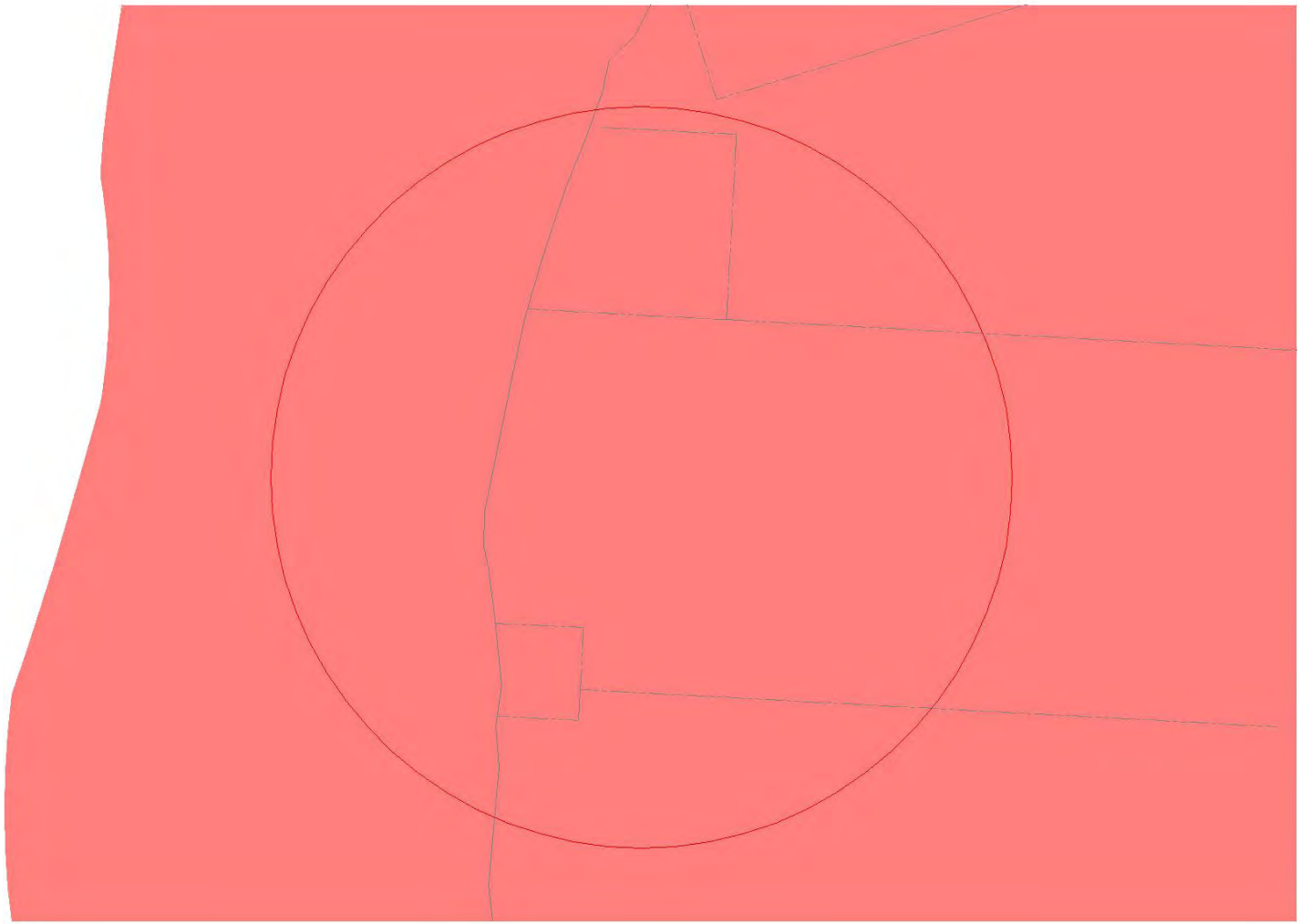
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25001C0633J

EFFECTIVE DATE
JULY 16, 2014

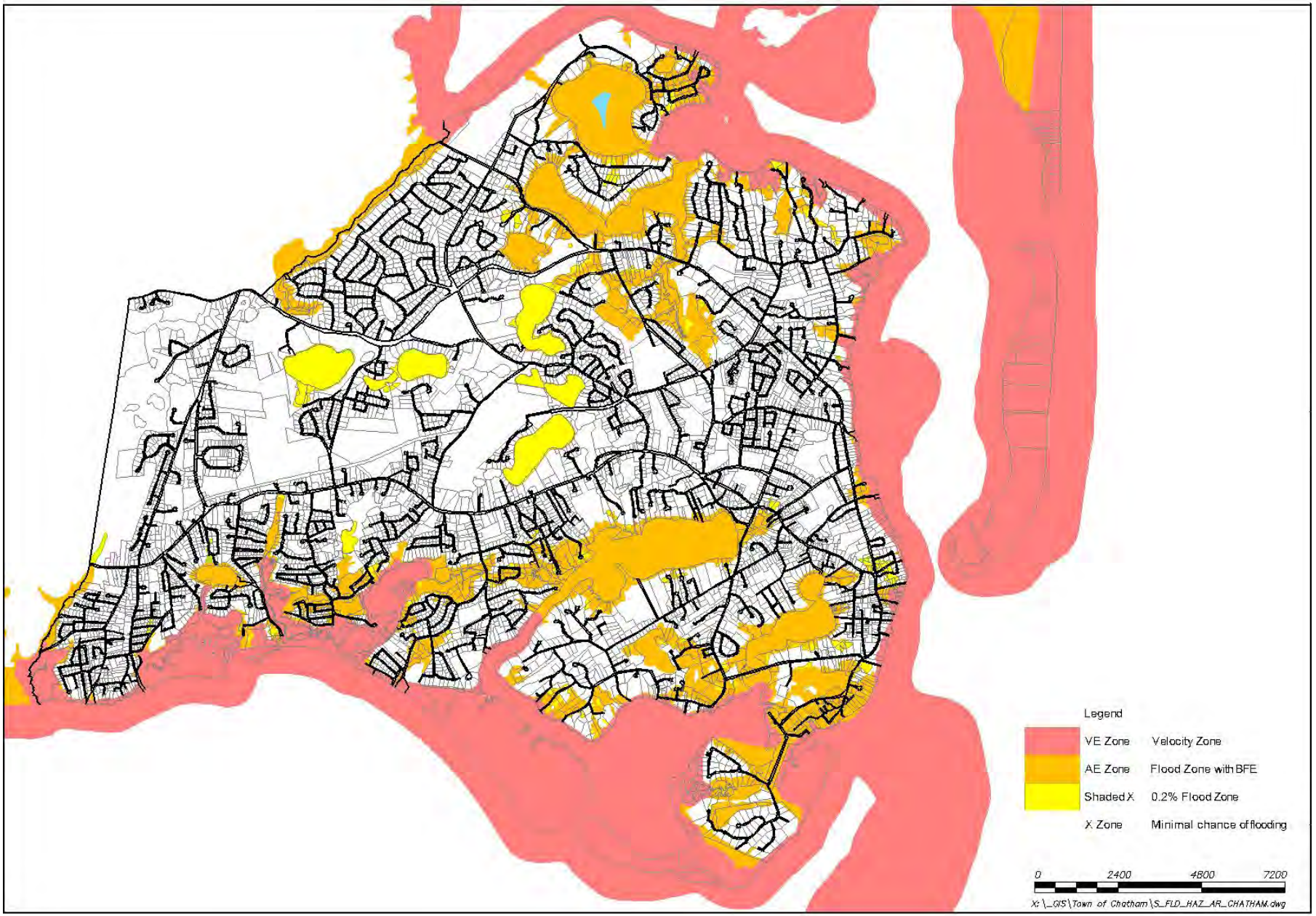
Federal Emergency Management Agency

GIS 2014



THE NEW MAPS

- The new maps are much better than the old maps.
- The new datalayer matches the new maps. These maps do not always match the ground conditions.
- The ground has not had a real chance to change except for fluctuant locations.
- The data is much better for parcel level evaluation.


Legend
VE Zone Velocity Zone
AE Zone Flood Zone with BFE
Shaded X 0.2% Flood Zone
X Zone Minimal chance of flooding
0
2400
4800
7200
X:_GIS\Town of Chatham\S_FLD_HAZ_AR_CHATHAM.dwg

Dissecting the new maps.

- The vertical data comes from aerial lidar information. (“Lasers”)
- The lidar data was then gridded into GeoTiffs.
- The grid cell size is a meter or greater.
- The vertical accuracy varies (0.2’ – 0.5’ – N/A).
- The underlying aerial orthophotographs are from the MassGIS archives. (In Massachusetts)

The Lidar geotiffs are available from MassGIS.

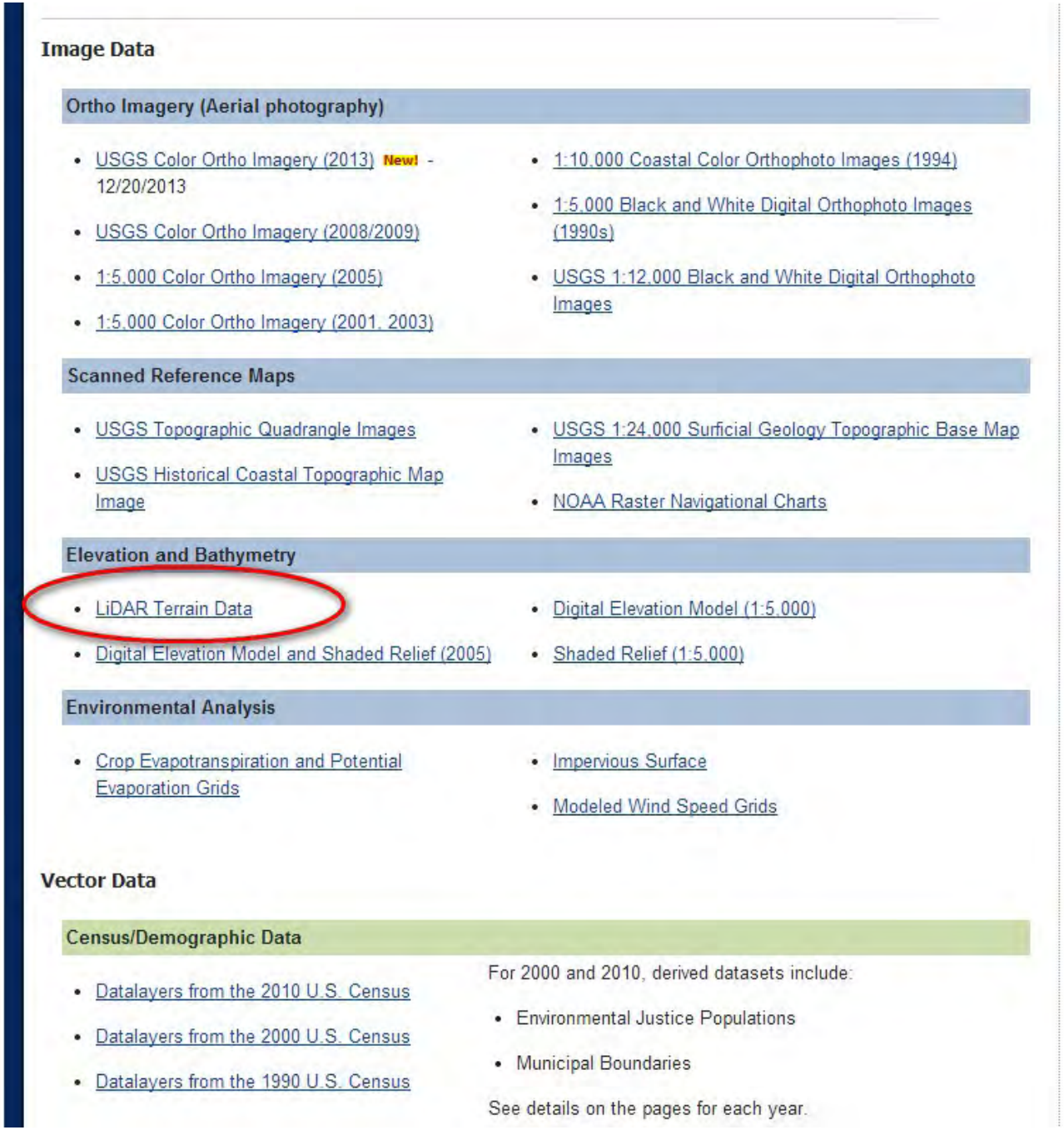


Image Data

Ortho Imagery (Aerial photography)

- USGS Color Ortho Imagery (2013) New! - 12/20/2013
- USGS Color Ortho Imagery (2008/2009)
- 1:5,000 Color Ortho Imagery (2005)
- 1:5,000 Color Ortho Imagery (2001, 2003)
- 1:10,000 Coastal Color Orthophoto Images (1994)
- 1:5,000 Black and White Digital Orthophoto Images (1990s)
- USGS 1:12,000 Black and White Digital Orthophoto Images

Scanned Reference Maps

- USGS Topographic Quadrangle Images
- USGS Historical Coastal Topographic Map Image
- USGS 1:24,000 Surficial Geology Topographic Base Map Images
- NOAA Raster Navigational Charts

Elevation and Bathymetry

- LiDAR Terrain Data
- Digital Elevation Model and Shaded Relief (2005)
- Digital Elevation Model (1:5,000)
- Shaded Relief (1:5,000)

Environmental Analysis

- Crop Evapotranspiration and Potential Evaporation Grids
- Impervious Surface
- Modeled Wind Speed Grids

Vector Data

Census/Demographic Data

- Datalayers from the 2010 U.S. Census
- Datalayers from the 2000 U.S. Census
- Datalayers from the 1990 U.S. Census

For 2000 and 2010, derived datasets include:

- Environmental Justice Populations
- Municipal Boundaries

See details on the pages for each year.

MassGIS LiDAR Terrain Data Project Area Summary

Project Name	Acquisition Dates	No. of Returns	Average Point Spacing	Vertical Accuracy	Raster DEM Resolution	Points Delivered	Contours Delivered	Intensity	Projection Information
2002 Boston Area	April, 2002	2	1.25 / 0.75 m	0.14983 m RMSE	1 m	* First return XYZ * Last return XYZ	NA	First return only (raster)	MA SPC NAD83/NAVD88 Meters
2004 Hampden County	May-July, 2004	NA	10 ft	0.483 ft RMSE	10 ft	Variably-spaced Bare Earth XYZ	2 ft	NA	MA SPC NAD83/NAVD88 Feet
2004 Southeast Pilot	April 30, 2004	3	*A	NA	2 m	* LAS (Non-std classification) * TIN	NA	All returns in LAS file	MA SPC NAD83/NAVD88 Meters
2005 Blackstone River	NA	NA	NA	NA	8 ft	TIN	2 ft	NA	MA SPC NAD83/NAVD88 Feet
2006 Bristol County	Nov. 10-26, 2006	NA	1.4 m	*B	4 ft	* First XYZ * Last XYZ * Mass pts. XYZ * TIN	2 ft	5 ft raster	MA SPC NAD83/NAVD88 Feet
2006 Plymouth County South	Nov. 10-26, 2006	NA	1.4 m	*B	4 ft	* First XYZ * Last XYZ * Mass pts. XYZ * TIN	2 ft	5 ft raster	MA SPC NAD83/NAVD88 Feet
2006 Shawsheen River	Dec. 16, 2006	NA	3 m	*B	1 m	LAS 1.1 (ground points only)	NA	NA	MA SPC NAD83/NAVD88 Meters
2009 City of Boston	Nov. 9-10, 2009	4	1.0 m	0.204 ft RMSEz for 16 pts	3.28 ft	* LAS 1.1 * 2D non-ground point shapefile with Z value	NA	All returns in LAS file	MA SPC NAD83/NAVD88 Feet
2010 Concord River	Dec. 2-12, 2010	4	< 1.0 m	FVA = 0.178 m	1 m	Ground-classified LAS 1.2	NA	All returns in LAS file	UTM Zone 19N NAD83/NAVD88 Meters
2010 Charles River	Dec. 2-11, 2010	4	0.6 m	FVA = 0.186 m	1 m	Ground-classified LAS 1.2	NA	All returns in LAS file	UTM Zone 19N NAD83/NAVD88 Meters
2010 Quincy	Dec. 17, 2010	4	1.1 m	FVA = 0.057 m	1 m	Ground-classified LAS 1.2	NA	All returns in LAS file	UTM Zone 19N NAD83/NAVD88 Meters
2010 Narragansett River	Dec. 8-10, 2010	4	0.6 m	FVA = 0.166 m	1 m	Ground-classified LAS 1.2	NA	All returns in LAS file	UTM Zone 19N NAD83/NAVD88 Meters
2010 Blackstone River	Dec. 15-17, 2010	4	0.6 m	FVA = 0.167 m	1 m	Ground-classified LAS 1.2	NA	All returns in LAS file	UTM Zone 19N NAD83/NAVD88 Meters
2010 Dukes County	NA	4	3 ft	FVA = 0.47 ft	1 m	* Bare Earth XYZ * TIN	2ft 3D	All returns in LAS file	MA SPC Island Zone NAD83/NAVD88 Feet
2010 Nantucket	NA	4	3 ft	FVA = 0.47 ft	1 m	* Bare Earth XYZ * TIN	2 ft 3D	All returns in LAS file	MA SPC Island Zone NAD83/NAVD88 Feet
2011 Nashua River	May 6-7, 2011	4	0.92 m	FVA = 0.172 m	1 m	Ground-classified LAS 1.2	NA	All returns in LAS file	UTM Zone 19N NAD83/NAVD88 Meters
2011 LiDAR for the Northeast	Winter-Spring 2011 *C	4	< 1 m	FVA = 0.30 m *D	1 m	Ground-classified LAS 1.2	NA	All returns in LAS file	UTM Zone 19N NAD83/NAVD88 Meters

Notes:

*A Scan lines show paired points approximately 0.6 m apart, and 2.3 m along scan, and 2.65 m between lines, 3.25 m between centers of paired lines.

*B The bare-earth points have a Fundamental Vertical Accuracy of 1.2 ft. (36.3 cm) or better at the 95% confidence level in open terrain

*C LiDAR data acquired along the Massachusetts coast was flown at Daily Predicted Low Tide plus or minus 90 minutes.

*D Barnstable County was flown and processed to meet a bare earth Fundamental Vertical Accuracy (FVA) of 18.13 cm at a 95% confidence level, derived according to NSSDA, i.e., based on vRMSE of 9.25 cm in the "open terrain" land cover category.

Abbreviations:

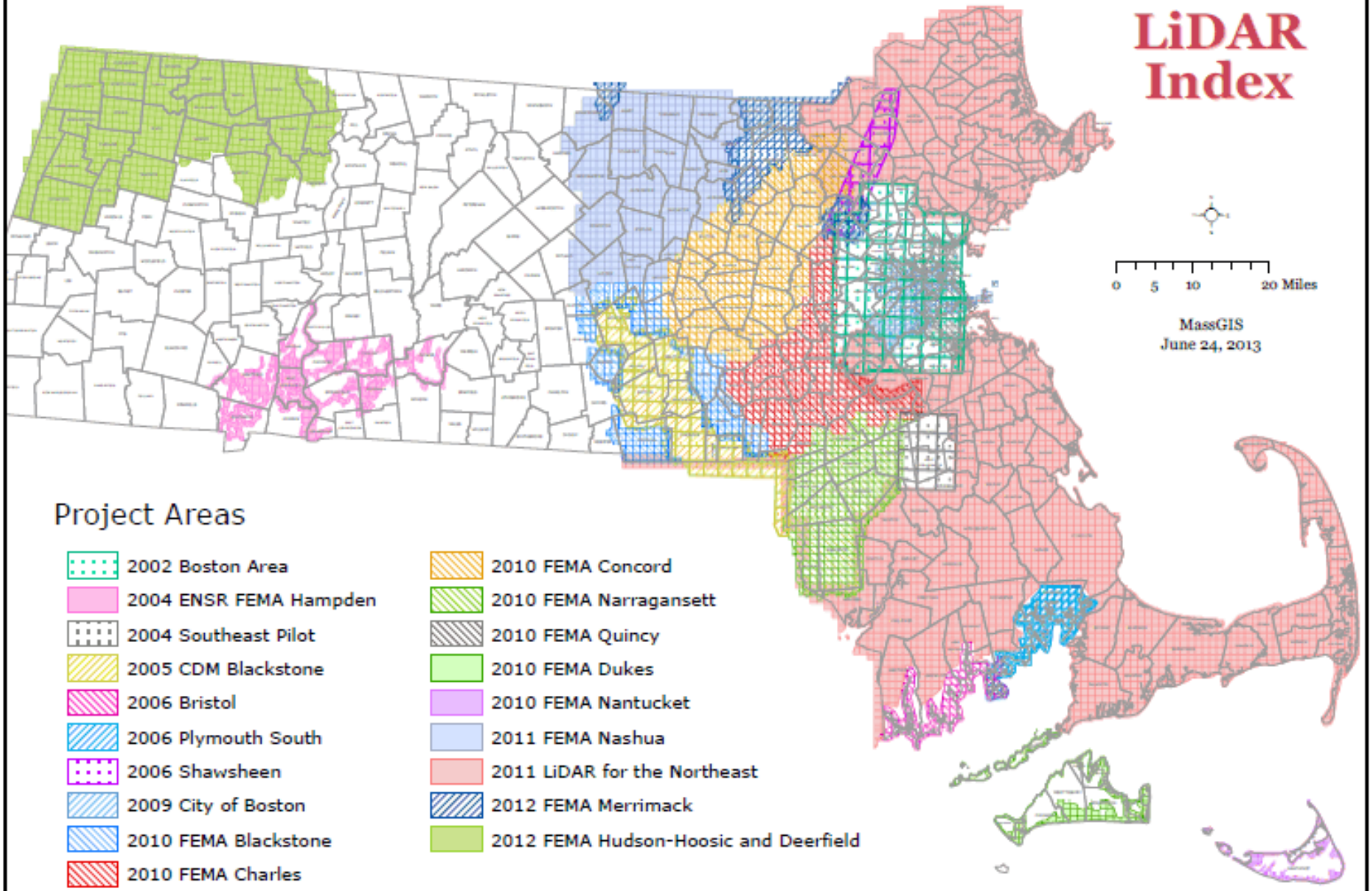
RMSE Root Mean Square Error

FVA Fundamental Vertical Accuracy

MA SPC *Massachusetts State Plane Coordinates*

July 20, 2012

LiDAR Index



0 5 10 20 Miles

MassGIS
June 24, 2013

Project Areas

- 2002 Boston Area
- 2004 ENSR FEMA Hampden
- 2004 Southeast Pilot
- 2005 CDM Blackstone
- 2006 Bristol
- 2006 Plymouth South
- 2006 Shawsheen
- 2009 City of Boston
- 2010 FEMA Blackstone
- 2010 FEMA Charles
- 2010 FEMA Concord
- 2010 FEMA Narragansett
- 2010 FEMA Quincy
- 2010 FEMA Dukes
- 2010 FEMA Nantucket
- 2011 FEMA Nashua
- 2011 LiDAR for the Northeast
- 2012 FEMA Merrimack
- 2012 FEMA Hudson-Hoosic and Deerfield

City and Town Boundaries

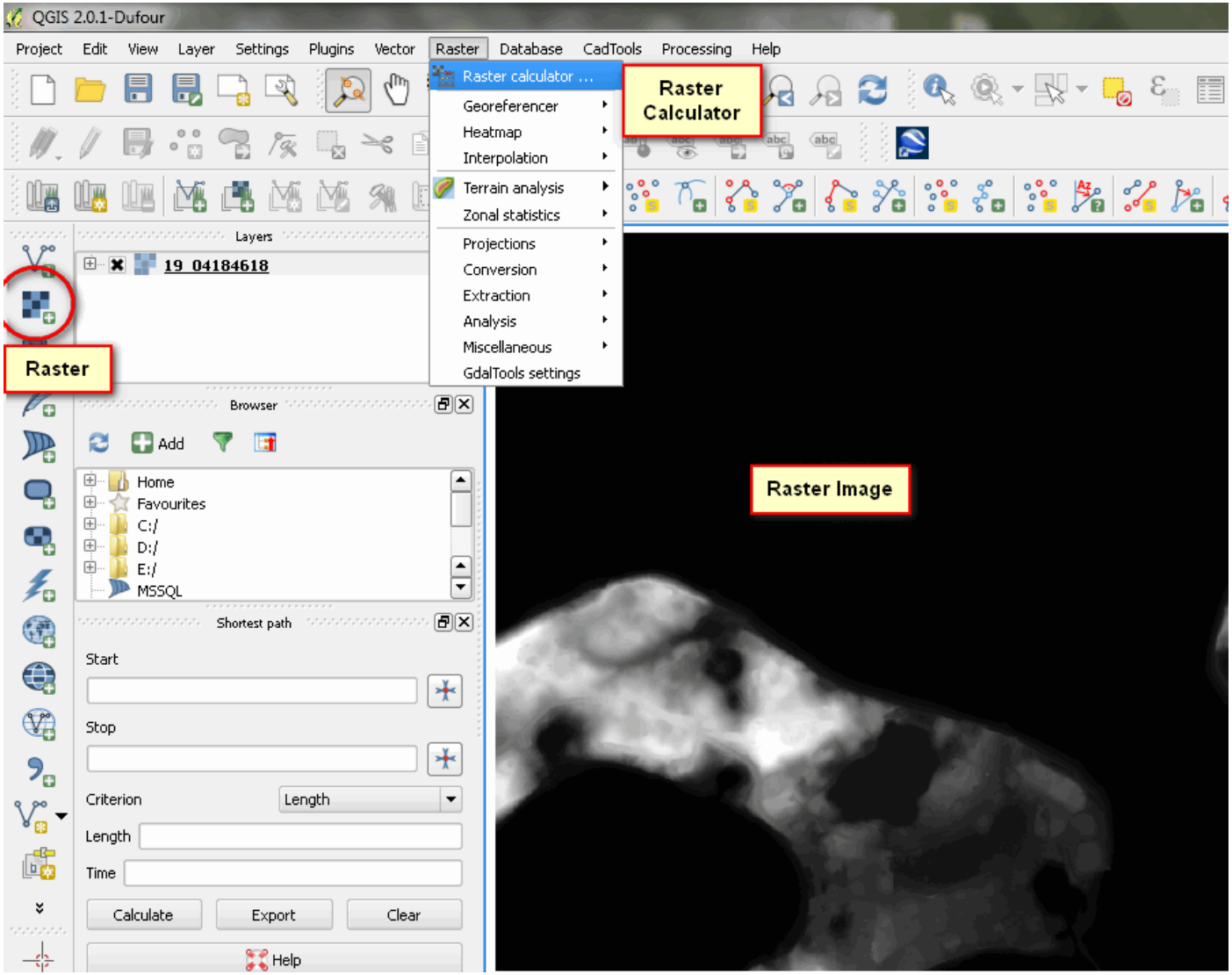
MASS GIS

Map projection:
NAD 1983 UTM Zone 19N

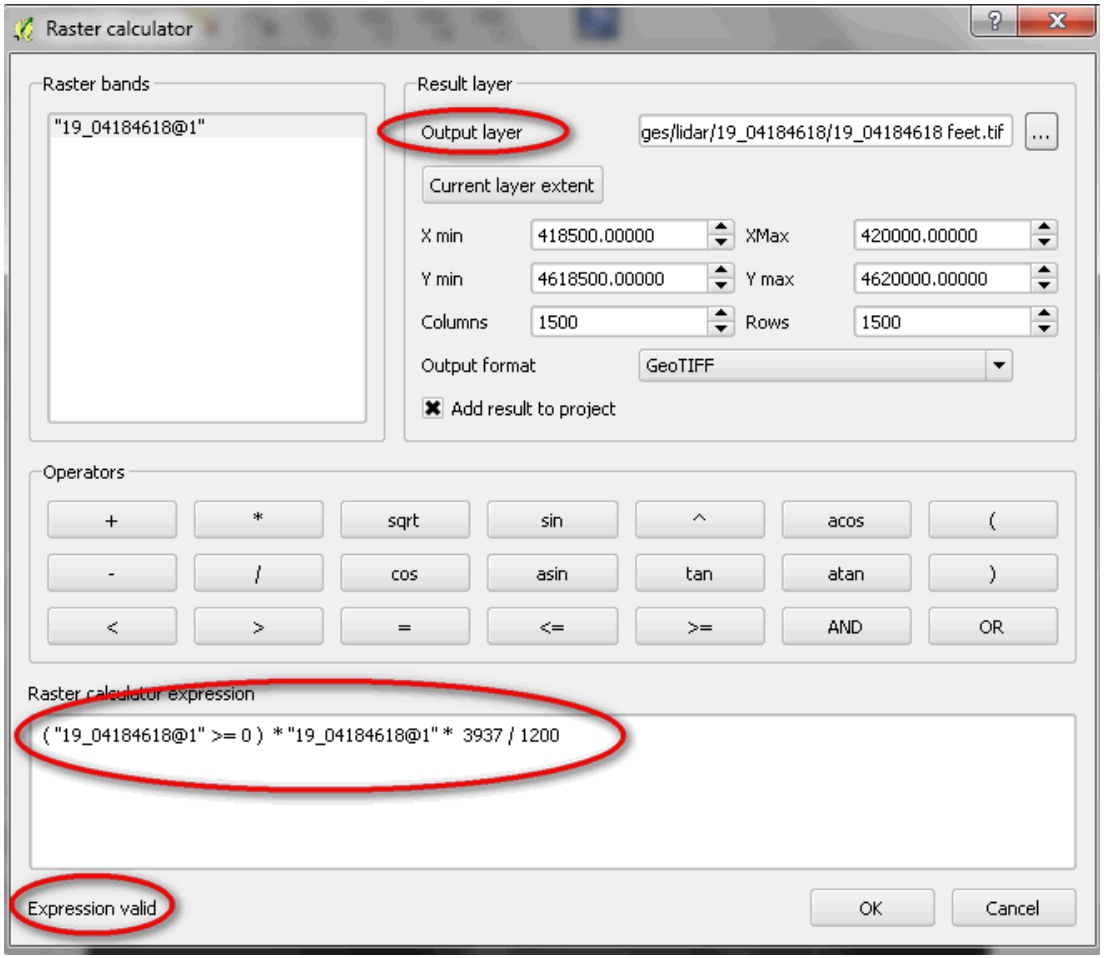
Converting lidar geotiffs to Contours

- GeoTiffs are not typically used with engineering plans.
- Some CAD products work well with GeoTiffs.
- Some ARC products will export some contours.
- QGIS (Quantum GIS) is a free means to convert GeoTiffs to contour shape files.

Import a geotiff into QGIS



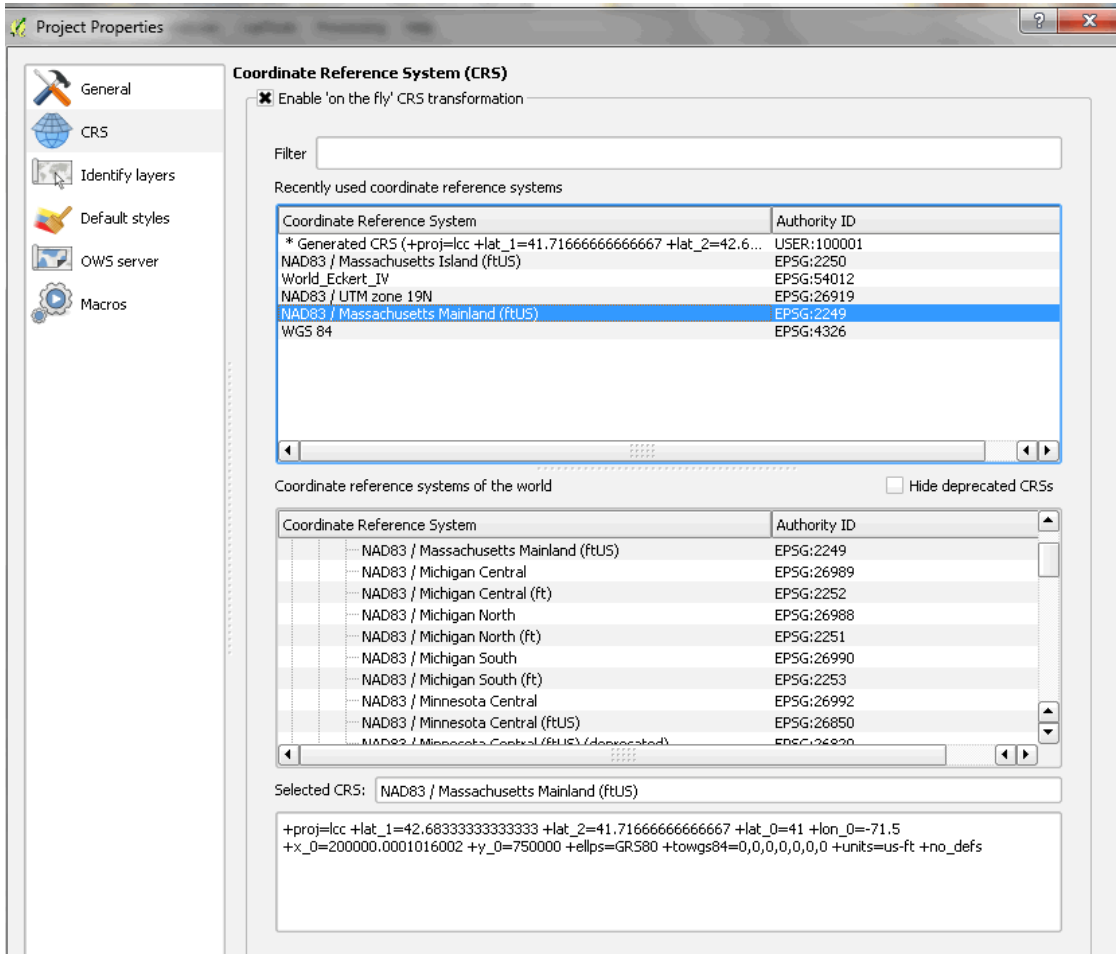
Raster Calculator will create a new geotiff with the vertical unit in feet.



Output to a new GeoTiff, the simplest means is to add the suffix ‘feet’ to the same filename.

The logical statement translates to:
If the cell value is greater than or equal to zero, then return that cell converted to feet.

Use project properties under the project menu to convert the horizontal datum.

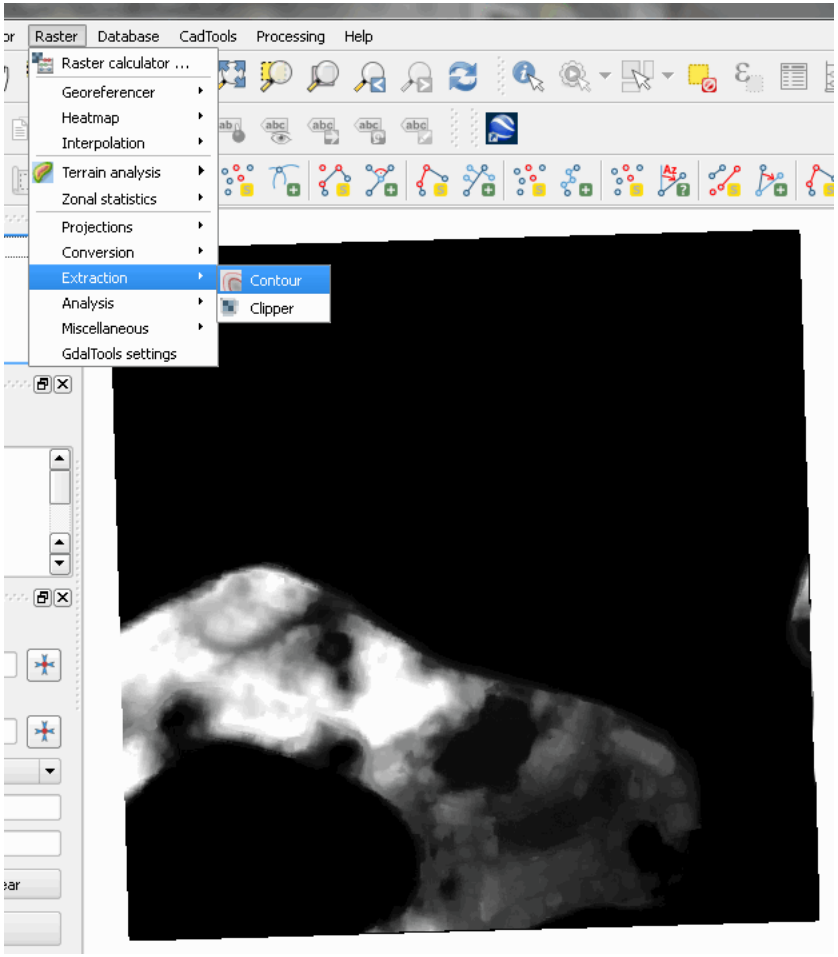


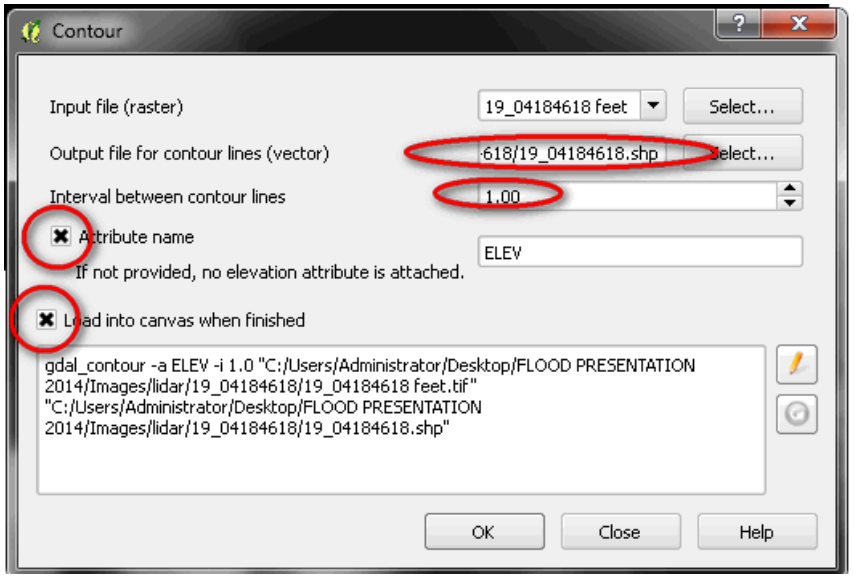
You must enable ‘On the Fly Conversion’

The list is long.

This is not necessary as other settings are needed to export a shape file in the coordinate system you want.

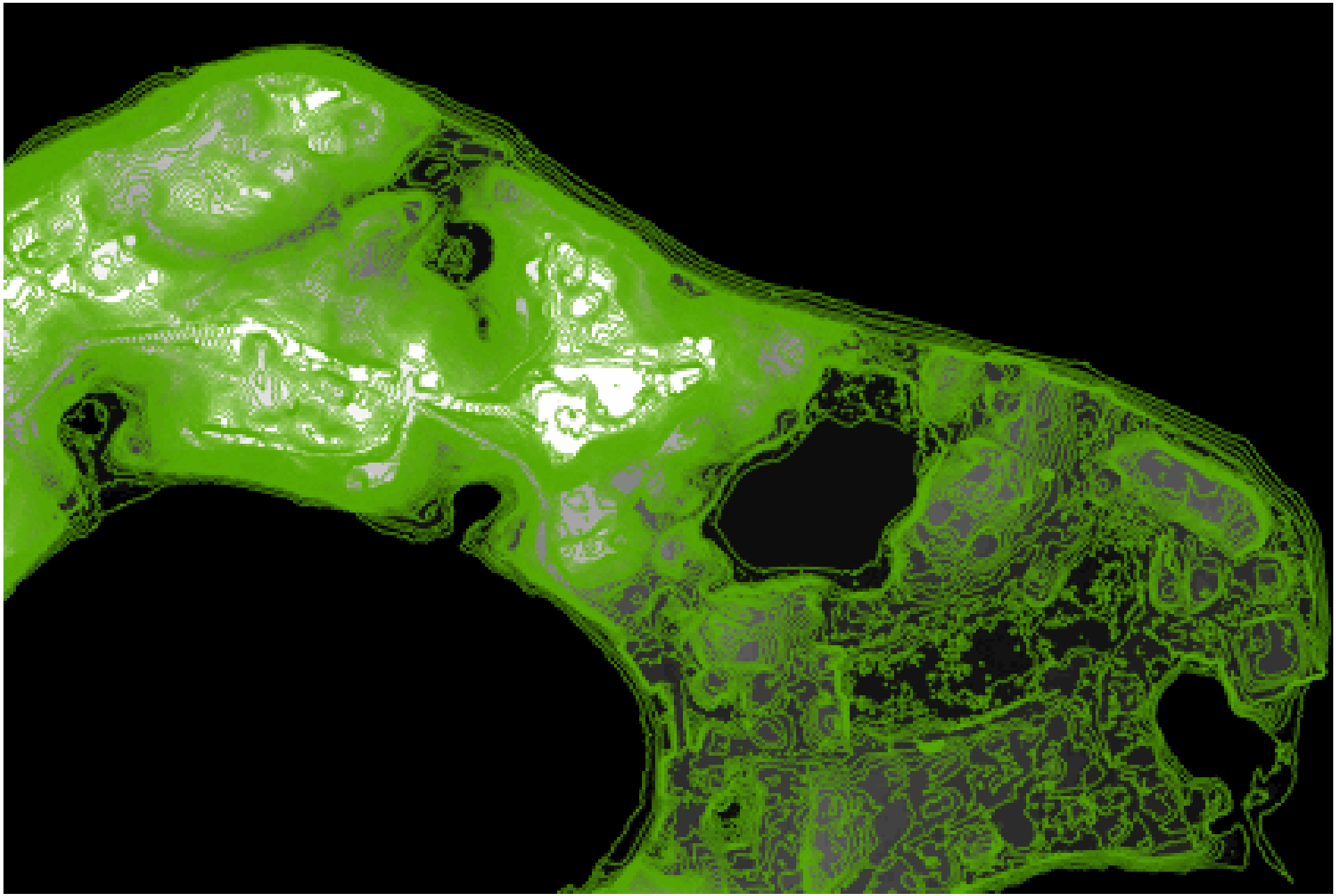
Now that everything is set in your desired coordinate system, you can extract some contours.





Select an output, a contour interval, an attribute and pull it into the current drawing.

Hit OK and…

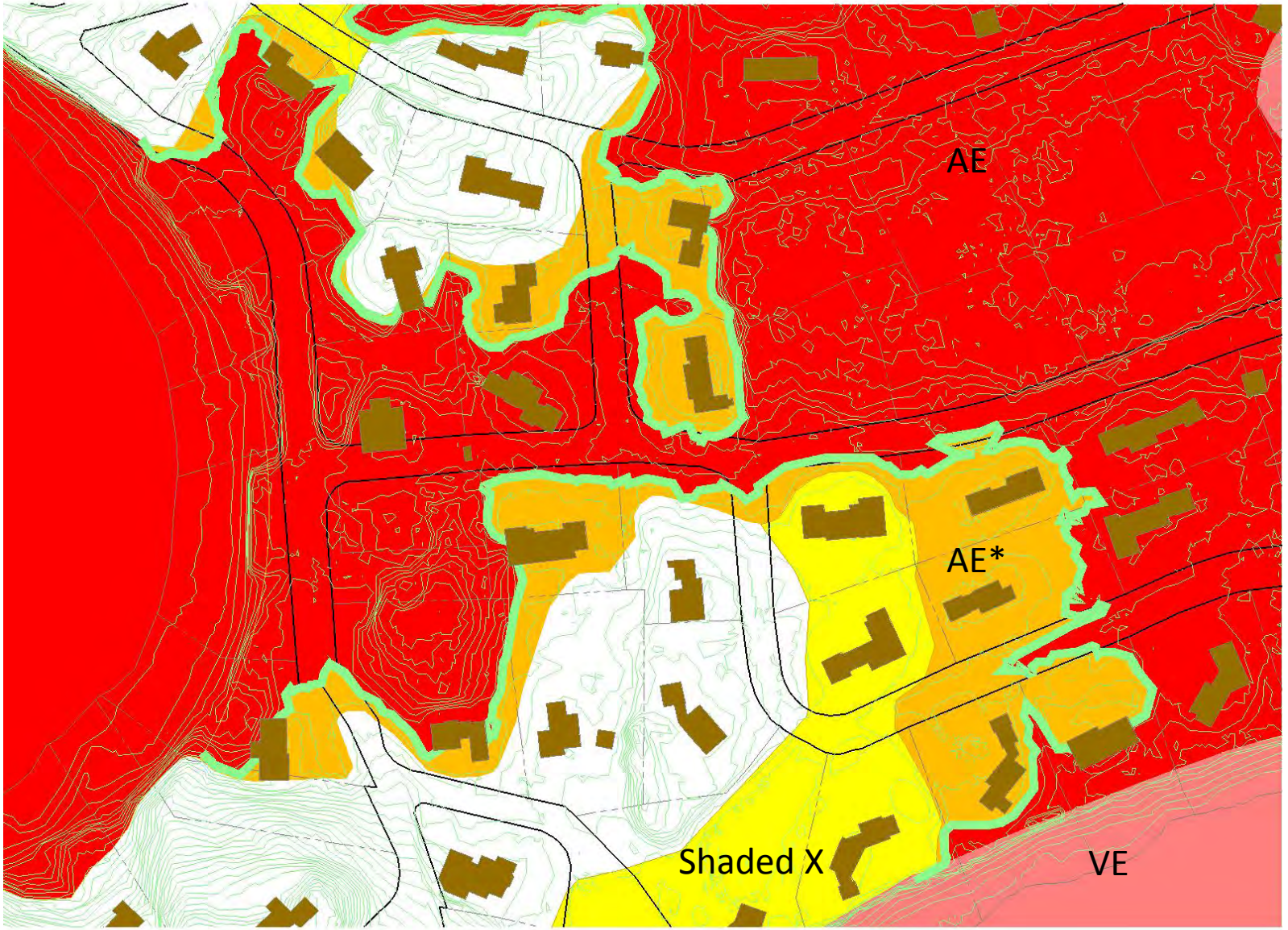


Now you are left to bring the shape file into CAD…
but why did we go through this exercise?

(Spoiler alert)

This happens to be in an area where the new FIRMs do not match the ground conditions.

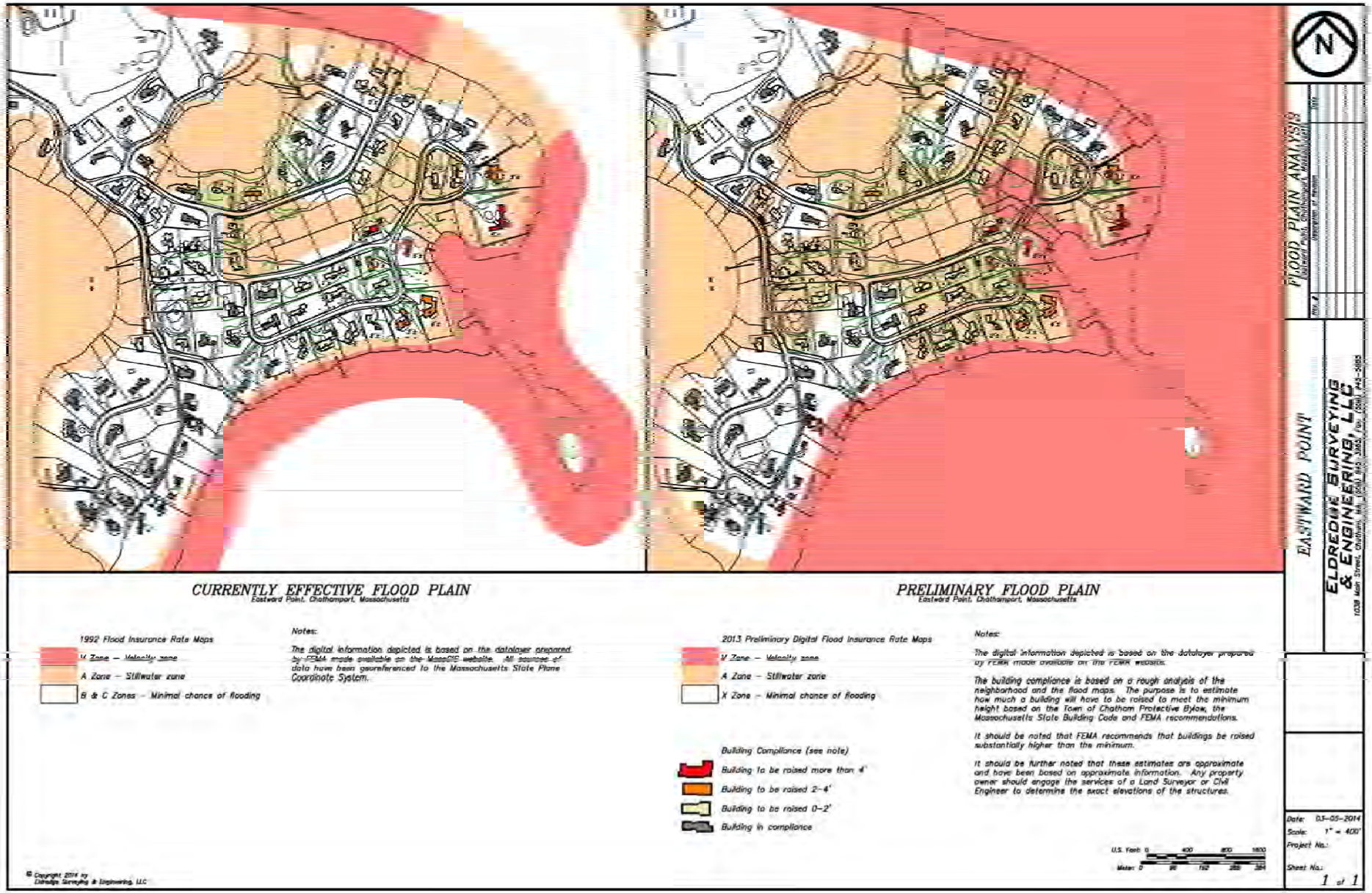
The areas in Orange are mapped AE but based on the lidar have elevations that exceed the BFE. The areas in red have elevation below the BFE.



- Good news: LOMAs will still be necessary!

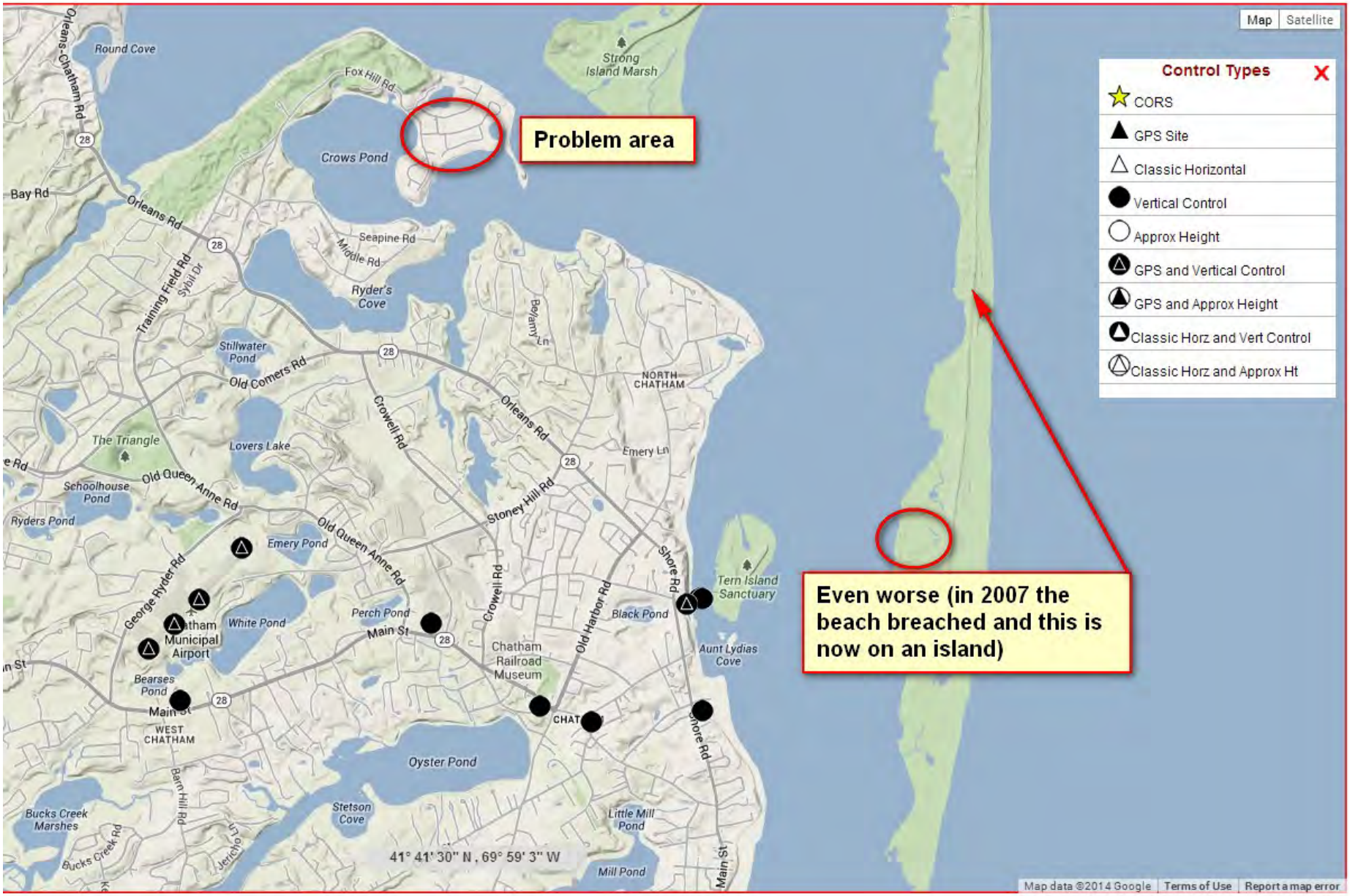
- Better news: It takes a minimal investment of time to identify properties and structures that will likely qualify for removal from the flood hazard zone.

This plan depicts the differences between the older flood maps and the new flood maps.



Benchmarks…

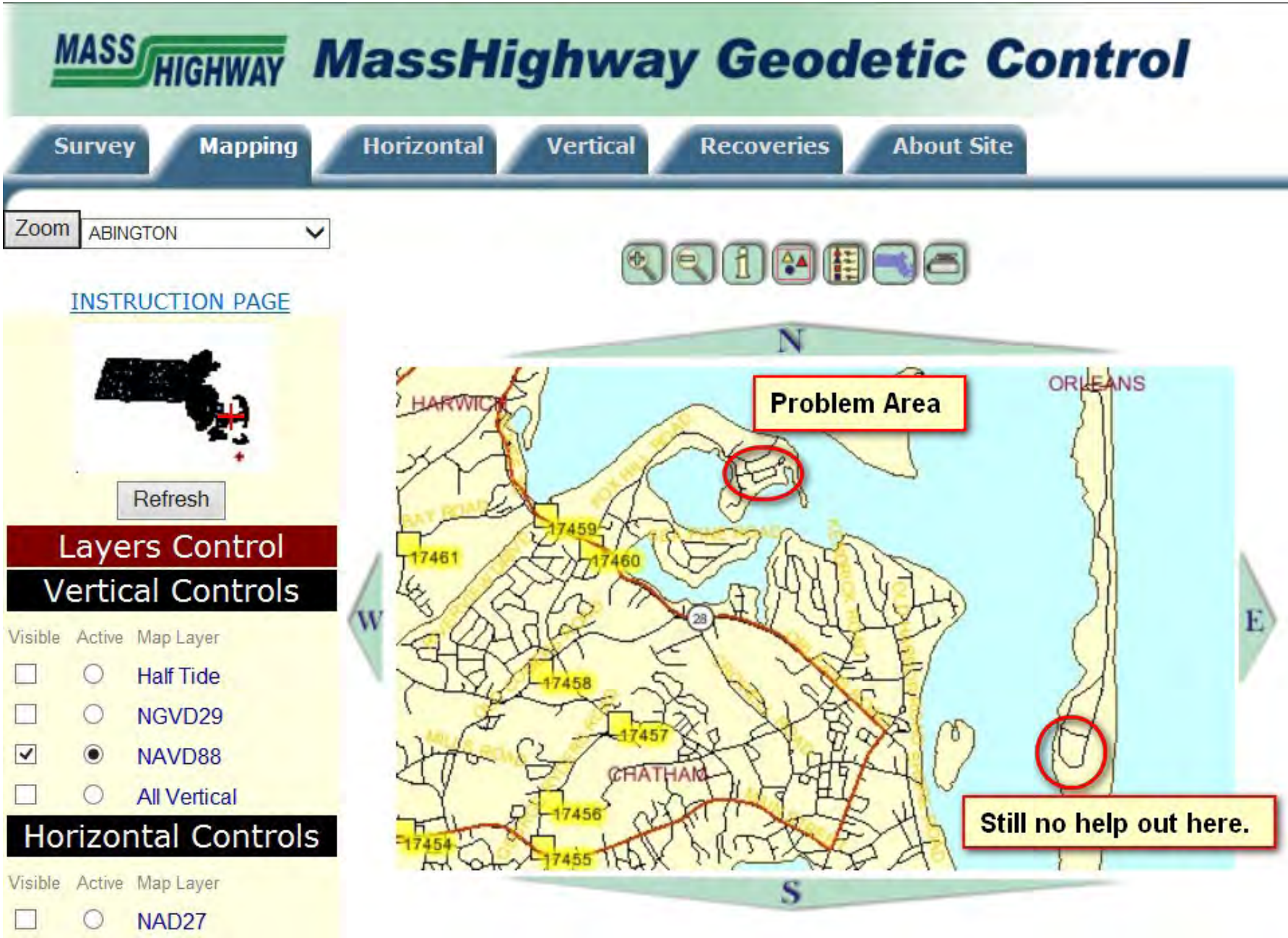
- The FIRMs have a limited number of benchmarks.
- The benchmarks come directly from the NGS database.
- The NGS may not have run levels or established benchmarks near a project. (The outer Cape, Orleans to Provincetown)


Problem area
Even worse (in 2007 the beach breached and this is now on an island)
Control Types
CORS
GPS Site
Classic Horizontal
Vertical Control
Approx Height
GPS and Vertical Control
GPS and Approx Height
Classic Horz and Vert Control
Classic Horz and Approx Ht
Map
Satellite
Round Cove
Strong Island Marsh
Fox Hill Rd
Crows Pond
Bay Rd
Orleans Rd
Seapine Rd
Middle Rd
Ryder's Cove
Training Field Rd
Sybil Dr
Stillwater Pond
Old Comers Rd
Bellamy Ln
NORTH CHATHAM
Crowell Rd
Orleans Rd
Emery Ln
The Triangle
Lovers Lake
Schoolhouse Pond
Old Queen Anne Rd
Ryders Pond
Stoney Hill Rd
Emery Pond
George Ryder Rd
Old Queen Anne Rd
Shore Rd
Tern Island Sanctuary
Black Pond
Old Harbor Rd
Perch Pond
Main St
White Pond
Municipal Airport
Chatham Railroad Museum
Aunt Lydias Cove
Bearses Pond
WEST CHATHAM
Oyster Pond
Barn Hill Rd
Bucks Creek Marshes
Stetson Cove
Little Mill Pond
Bucks Creek Rd
Jericho Ln
41° 41' 30" N , 69° 59' 3" W
Mill Pond
Map data ©2014 Google
Terms of Use
Report a map error

MassDOT to the rescue?

Select	MHD_ID	Station	Quad	Datum	Order	Elevation	Datum2	Order2	Elevation2	Description	Sketch
☐	17487	8471	HARWICH	NAVD88	2nd	18.322	-	-	-	LOCATED IN THE WESTERN SECTION OF CHATHAM, ABOUT 0.35 MILE NORTH ALONG ROUTE 134(MEETINGHOUSE ROAD)FROM THE JUNCTION OF ROUTE 28. THE MARK IS A BRASS RIVET SET IN THE NORTH END OF A CONCRETE HEADWALL THAT IS ABOUT 4.0 FT.BELOW THE LEVEL OF THE ROAD. THE MARK IS 102.7 m(337.0 FT.) SOUTH OF THE CENTER OF MIDDLE ROAD 15.8 m(52.0 FT.) SOUTHEAST OF POLE 9232/5 8.0 m(26.3 FT.) EAST OF THE CENTER OF ROUTE 137 4.0 m(13.0 FT.) NORTH OF THE EXTENDED CENTER O	Yes
☐	17460	8127	CHATHAM	NAVD88	2nd	15.761	-	-	-	LOCATED IN THE WESTERN SECTION OF CHATHAM, ON ROUTE 28, ABOUT 0.35 MILE SOUTHEAST OF THE HARWICH-CHATHAM TOWNLINE, AND AT THE INTERSECTION OF ROUTE 28 WITH FOX HILL ROAD AND TRAINING FIELD ROAD THE MARK IS A BRASS DISK, WITH NO WRITING OR LETTERING ON IT, SET IN THE TOP OF A CONCRETE BOUND THAT IS ABOUT LEVEL WITH THE ROAD.THE MARK IS IN THE AREA WHERE TRAVERSE STATION 111-R USED TO BE, 111-R IS ASSUMED TO BE DESTROYED. THE MARK IS 85.2 FT.SW OF POLE 8/1 71.4 FT.SOUTH OF THE CENTER OF FOX HILL RD	Yes
☐	17458	8102	CHATHAM	NAVD88	2nd	17.336	-	-	-	LOCATED IN THE NORTHWEST CENTRAL SECTION OF CHATHAM, AT THE TRIANGLE (THE OLD TRAINING FIELD), AT THE INTERSECTION OF TRAINING FIELD ROAD, OLD COMERS ROAD AND OLD QUEEN ANNE ROAD THE MARK IS A BRASS RIVET SET IN THE WEST END OF A 10 FT.LONG CONCRETE HEADWALL THAT IS ABOUT 3.4 FT.BELOW THE LEVEL OF THE ROAD.THE MARK IS 675.0 FT.WEST OF THE CENTER OF TRAINING FIELD ROAD 308.0 FT.EAST OF THE APPROXIMATE EAST SIDE OF THE SMALL POX CEMETERY 30.2 FT.SOUTH OF THE CENTER OF OLD COMERS RD	Yes
☐	17457	8101	CHATHAM	NAVD88	2nd	19.450	-	-	-	LOCATED IN THE CENTRAL SECTION OF CHATHAM, AT THE INTERSECTION OF GEORGE RYDER ROAD AND OLD QUEEN ANNE ROAD, AT THE OLDEST CEMETERY IN CHATHAM. THE MARK IS A BRASS RIVET SET IN A GRANITE OUTCROP AT THE ENTRANCE TO THE NORTH GRAVEYARD.THE MARK IS 0.3 FT.BELOW THE HIGHEST POINT OF OUTCROP AND IS ABOUT 3.3 FT.ABOVE THE LEVEL OF THE ROAD.THE MARK IS 83.2 FT.EAST OF POLE 57/30 80.1 FT.WEST OF THE EXTENDED CENTER OF GEORGE RYDER ROAD	Yes
☐	17456	8100	CHATHAM	NAVD88	2nd	15.760	-	-	-	LOCATED IN THE WEST CHATHAM SECTION OF CHATHAM, ABOUT 0.25 MILE NORTH ALONG GEORGE RYDER ROAD FROM THE JUNCTION OF ROUTE 28, AT THE BROWN JAMES BUCK VFW BLDG. THE MARK IS A BRASS RIVET SET IN THE TOP OF A CONCRETE RETAINING WALLAND IS ABOUT 2.7 FT.BELOW THE LEVEL OF THE ROAD. THE MARK IS 96.1 FT.NE OF POLE 54/9 52.0 FT.SE OF THE CENTER OF THE ROAD 1.5 FT.SOUTH OF THE SOUTHWEST CORNER OF THE BLDG.	Yes
☐	17455	8099	CHATHAM	NAVD88	2nd	12.148	-	-	-	LOCATED IN THE WEST CHATHAM SECTION OF CHATHAM, AT THE INTERSECTION OF ROUTE 28 AND GEORGE RYDER ROAD THE MARK IS A BRASS RIVET SET IN THE WEST SIDE OF A CONCRETE FOUNDATION FOR A LIGHT POLE AND IS ABOUT 0.8 FT.ABOVE THE LEVEL OF THE ROAD. THE MARK IS 173.8 FT.NORTH OF THE CENTER OF ROUTE 28 128.4 FT.SW OF THE SOUTHWEST CORNER AO THE A&P SUPERMARKET 39.0 FT.NE OF POLE 54/1 21.9 FT.NORTH OF THE CENTER OF THE ROAD LEADING	Yes
☐	17454	8098	HARWICH	NAVD88	2nd	3.867	-	-	-	LOCATED IN THE WESTERN SECTION OF CHATHAM, ABOUT 0.45 MILE EAST ALONG ROUTE 28 FROM THE JUNCTION OF ROUTE 137, AT A CULVERT FOR COCKLE COVE CREEK. THE MARK IS A BRASS RIVET SET IN THE WEST END OF A CONCRETE HEADWALL THAT IS ABOUT 13.5 FT.BELOW THE LEVEL OF THE ROAD. THE MARK IS 207.0 FT.EAST OF A FIRE HYDRANT 184.0 FT.WEST OF EVERGREEN LANE (A PRIVATE WAY) 53.0 FT.NORTH OF THE CENTER OF ROUTE 28	Yes
☐	17453	8097	HARWICH	NAVD88	2nd	5.671	-	-	-	LOCATED IN THE SOUTH CHATHAM SECTION OF CHATHAM, ON ROUTE 28, AT THE SOUTH CHATHAM POST OFFICE. THE MARK IS A BRASS RIVET SET IN THE SOUTHWEST END OF A CONCRETE LOADING PLATFORM AT THE BACK OF THE POST OFFICE AND IS ABOUT 3.0 FT.BELOW THE LEVEL OF THE ROAD. THE MARK IS 721.0 FT.(PACED)WEST OF ROUTE 137 185.4 FT.SOUTH OF THE CENTER OF ROUTE 28 46.7 FT.EAST OF THE SOUTHWEST CORNER OF THE BLDG. 14.2 FT.WEST OF THE SOUTHEAST CORNER OF THE BLDG.	Yes
☐	17452	8096	HARWICH	NAVD88	2nd	5.708	-	-	-	LOCATED ON ROUTE 28, AT THE HARWICH-CHATHAM TOWNLINE.THE MARK IS THE HIGH POINT ON TOP OF A ROUGH HEWN GRANITE BOUND(PRE HARBOR AND LANDS COMM.) SET SLIGHTLY ASKEW PROJECTING 0.6 FT.AND ABOUT 3.0 FT.BELOW THE LEVEL OF THE ROAD. THE MARK IS 86.3 FT.SE OF POLE666 29.3 FT.SOUTH OF THE CENTER OF ROUTE 28 25.6 FT.SW OF POLE 667 11.2 FT.SOUTH OF THE TOWNLINE SIGN	Yes
☐	17332	553	HARWICH	NGVD29	2nd	46.380	NAVD88	2nd	13.772	SW CORNER OF ABANDONED CONCRETE BASE FOR DERAIL PIPE, 271 FT EAST OF INTERSECTION OF MEETINGHOUSE ROAD AND ABANDONED RAILROAD.	Yes
☐	17327	68 P 4	HARWICH	NGVD29	2nd	14.320	-	-	-	IN THE WEST PART OF TOWN, 2.5 MI EAST OF HARWICHPORT, CHATHAM WATER WORKS. SET IN THE FLOOR OF THE PUMP ROOM, JUST INSIDE THE THRESHOLD ON THE EAST SIDE OF THE BUILDING AND AT THE NORTH END OF THE THRESHOLD. 68-P 4A....MONEL RIVET IN THE SOUTH END OF THE WESTERNMOST PIER UNDER A STEEL FUEL TANK, 60 FT NORTHEAST OF 68-P A. ELEV 18.96 FT. NOT FOUND 11/80. 68-P 4B....MONEL RIVET IN A CONCRETE MONUMENT UP 3 INCHES, AND 103 FT SOUTHEAST OF 68-P 4. ELEV 23.11 FT. NOT FOUND 11/80.	Yes

Google: MassDOT Survey and follow the links to the control points



This has worked better on IE (Internet Explorer) than in Chrome.

- Benchmarks are not convenient.
- Level runs for the miles and miles will ruin a project budget.
- Can we use GPS?

GPS was used to establish an elevation at the site on the Island.

Vertical Results with GPS

NOAA Technical Memorandum NOS NGS-58

GUIDELINES FOR ESTABLISHING GPS-DERIVED ELLIPSOID HEIGHTS (STANDARDS: 2 CM AND 5 CM)
VERSION 4.3

David B. Zilkoski
Joseph D. D'Onofrio
Stephen J. Frakes

Silver Spring, MD

November 1997

NOAA Technical Memorandum NOS NGS 59

Guidelines for Establishing GPS-Derived Orthometric Heights

David B. Zilkoski
Edward E. Carlson
Curtis L. Smith

National Geodetic Survey
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

26 March 2008

NGS Procedures

NGS-58

- Dual frequency GPS receivers.
- Reference to at least 3 existing A- or B- order 3-d control stations.
- For control and primary base stations, collect 5 hour simultaneous sessions on three different days in the project.
- For other stations, each baseline (adjacent station pair) must be occupied for a minimum of a 30 minute simultaneous session.
- Spacing cannot exceed 10 km, average spacing less than 7 km.
- Primary base stations

- 15 hours minimum for your first benchmark… 30 minutes minimum for each mark thereafter.

NGS-59

- Follow NGS-58 specifications.
- Use the latest geoid model (12A).
- Use the most recent datum (NAVD 88).
- Occupy stations with valid NAVD 88 orthometric heights with an even distribution throughout the project.
- Keep distances between valid NAVD 88 benchmarks to less than 20 km.
- In mountainous areas, occupy additional benchmarks at varying elevations.
- Perform 3-d minimally constrained least squares adjustment (hold one Lat/Long and one Ortho Height).
- Find and remove the outliers, reprocess and find and remove all outliers.
- Compute between the differences between the results and published elevations.
- Determine which benchmark elevations are suitable to use.
- Constrain all valid observations and elevations and create the final solution.
- Check the results for obvious distortions.

Really?
That much work for a benchmark?

- Shorter baselines.
- Tie into level loops
- Add observations into network solutions over many days.
- OPUS Projects. (OPUS)
- Networks solutions. Free, subscription or other data added can only better a solution.

What could go wrong?

- Avoid RTK GPS unless you have other suitable measurements.
- Avoid Trigonometric Leveling unless you have other suitable measurements.
- RTK locations of adequate points in a traverse loop could provide suitable results.
- RTK can be helpful to verify level runs, trigonometric levels and traverses.

- Test your methods and determine your level of comfort.
- Test the information you rely upon. Question everything.

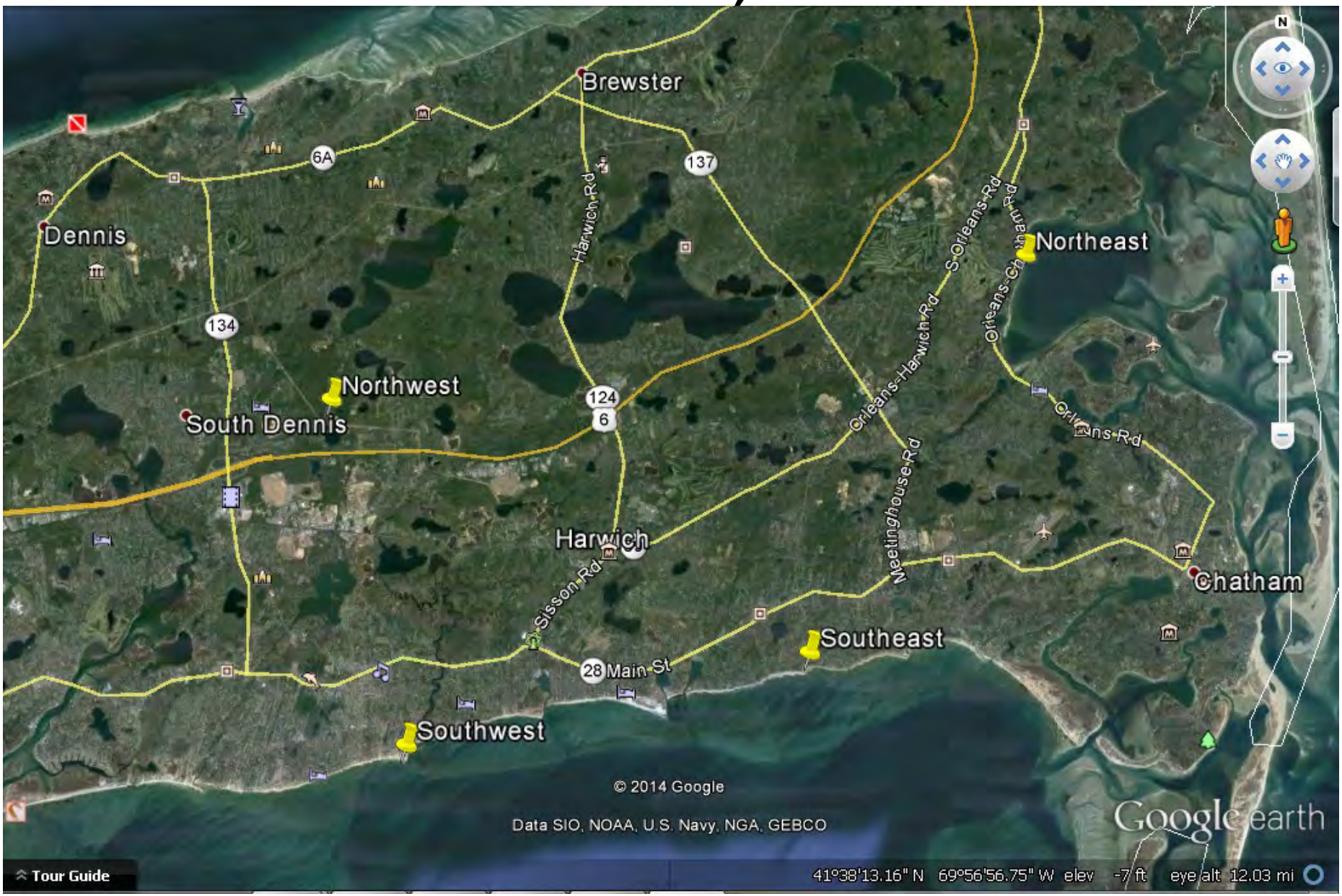
VertCon / CorpsCon

- CorpsCon uses the Vertcon Model for the conversion between NGVD 29 and NAVD 88.

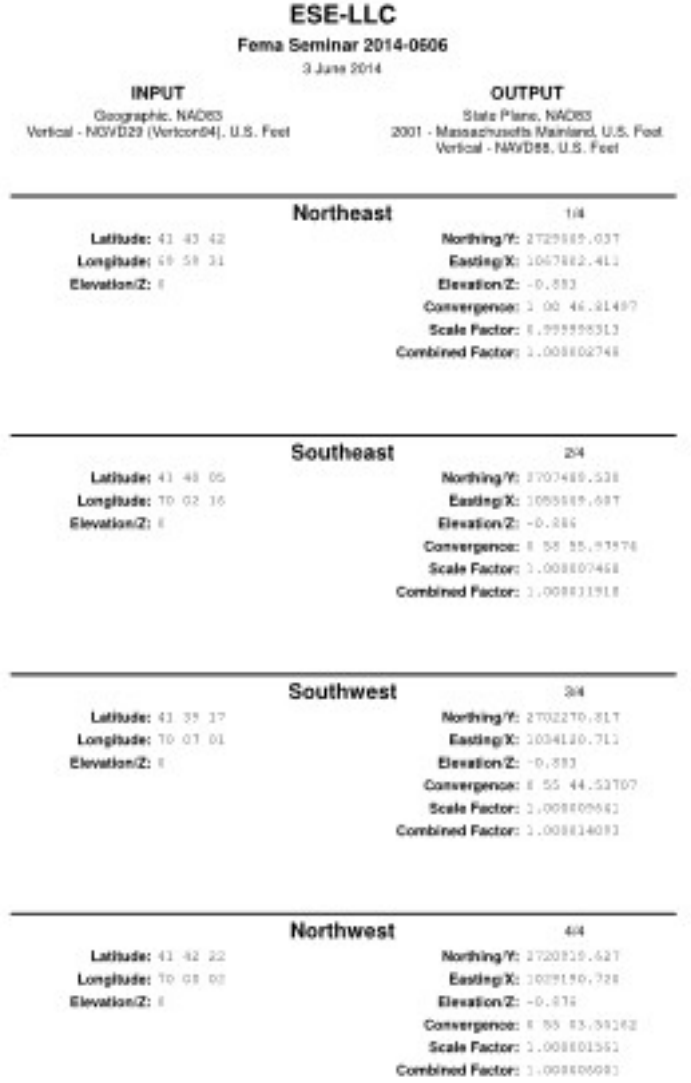
- The VertCon documentation claims that it is not suitable for 1st, 2nd or 3rd Order Heights. (3rd Order = 0.05’ per root mile (square root))

- Verification of the VertCon model can and should be completed before considering relying upon it.

Harwich, MA


Brewster
6A
137
Harwich Rd
Dennis
Northeast
S Orleans Rd
Orleans-Harwich Rd
134
Northwest
South Dennis
124
6
Orleans Rd
Meetinghouse Rd
Harwich
Chatham
Sisson Rd
Southeast
28 Main St
Southwest
© 2014 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google earth
Tour Guide
41°38'13.16" N 69°56'56.75" W elev -7 ft eye alt 12.03 mi

Using the Google Earth coordinates, CorpsCon will quickly provide the calculated difference between NGVD and NAVD



ESE-LLC

Fema Seminar 2014-0506

3 June 2014

INPUT	OUTPUT
Geographic, NAD83 Vertical - NGVD29 (Vertcon04), U.S. Feet	State Plane, NAD83 2001 - Massachusetts Mainland, U.S. Feet Vertical - NAVD88, U.S. Feet

Northeast 1/4

Latitude: 41 43 42
Longitude: 69 58 31
Elevation/Z: 0

Northing/Y: 2720989.037
Easting/X: 1067882.412
Elevation/Z: -0.883
Convergence: 1 00 46.81497
Scale Factor: 0.999998513
Combined Factor: 1.000002748

Southeast 2/4

Latitude: 41 40 05
Longitude: 70 02 16
Elevation/Z: 0

Northing/Y: 2707488.538
Easting/X: 1055989.687
Elevation/Z: -0.886
Convergence: 0 58 55.97978
Scale Factor: 1.000007468
Combined Factor: 1.000011918

Southwest 3/4

Latitude: 41 39 17
Longitude: 70 07 01
Elevation/Z: 0

Northing/Y: 2702270.817
Easting/X: 1034120.711
Elevation/Z: -0.883
Convergence: 0 55 44.53707
Scale Factor: 1.000005561
Combined Factor: 1.000014093

Northwest 4/4

Latitude: 41 42 22
Longitude: 70 08 02
Elevation/Z: 0

Northing/Y: 2720819.627
Easting/X: 1029150.728
Elevation/Z: -0.876
Convergence: 0 55 43.59162
Scale Factor: 1.000001561
Combined Factor: 1.000006081

MassDOT benchmark lists provide NGVD data and NAVD data

☐	17369	551	DENNIS	NGVD29	2nd	40.820	-	-	-	TOP OF SECOND BUTTRESS FROM NORTHWEST CORNER ON WEST SIDE OF OLD COLONY NARROW FABRIC CO, 366 FT WEST OF INTERSECTION OF DEPOT AVE AND NH RAILROAD (CHATHAM BRANCH), 69.0 FT SOUTH OF SOUTH RAIL. NOW AN AUTO JUNK YARD.	Yes
☐	17368	545	DENNIS	NGVD29	2nd	22.570	-	-	-	SW CORNER WEST BRIDGE SEAT OF NH RAILROAD (BOSTON DIV) TRESTLE OVER COAL POCKET, 509 FT EAST OF INTERSECTION OF DEPOT STREET, 49.5 FT SOUTH OF SOUTH RAIL.	Yes
☐	17345	E 35	HARWICH	NGVD29	2nd	51.64	NAVD88	2nd	9.298	AT THE NORTHEAST CORNER, SECOND COURSE, EAST WINGWALL OF THE SOUTH ABUTMENT OF THE KELLEY STREET BRIDGE (34.66) OVER THE ABANDONED RAILROAD.	Yes
☐	17343	AA 35	HARWICH	NGVD29	2nd	60.100	-	-	-	AT AREA OF ENTRANCE TO BASEMENT ON WEST SIDE OF TOWN HALL, MAIN STREET.	No
☐	17342	10346	HARWICH	NGVD29	2nd	27.095	-	-	-	ON THE NORTH SIDE OF ROUTE 28, 20.0 FT NORTH OF THE CENTERLINE, ABOUT 650 FT EAST OF THE JUNCTION WITH LOWER COUNTY ROAD, 23.6 FT EAST OF A 20 INCH ELM, 21.6 WEST OF A 24 INCH ELM, 18.6 FT NORTHWEST OF POLE 103/38, 8.0 FT SOUTH OF THE SOUTH TRUNK OF A TWIN 4 INCH ELM.	Yes
☐	17341	10345	HARWICH	NGVD29	2nd	20.326	-	-	-	ON THE SOUTH SIDE OF LOWER COUNTY ROAD, ABOUT 0.2 MI WEST OF ROUTE 28, 36 FT WEST OF THE CENTERLINE EXTENDED OF WYNDMERE AVE IN HARWICHPORT, 57.5 FT NORTHEAST OF THE NORTHWEST CORNER OF CAPECES HOUSE, 39.5 FT NORTHEAST OF THE NORTHEAST CORNER, 16.0 FT SOUTH OF THE CENTERLINE OF LOWER COUNTY ROAD, 10.9 FT NORTHEAST OF CENTER OF MANHOLE.	Yes
☐	17340	10344	HARWICH	NGVD29	2nd	15.167	-	-	-	ON THE NORTHEAST SIDE OF LOWER COUNTY ROAD IN THE SOUTHWEST SECTION OF TOWN, 42.3 FT EAST OF A 12 INCH POPLAR TREE ON THE WEST SIDE, 15.8 FT WEST OF A 14 INCH PINE ON THE EAST SIDE, 11.3 FT SOUTHEAST OF POLE 49/7, 5.5 FT NORTHWEST OF THE END POST OF A WOOD FENCE.	Yes
☐	17339	10341	HARWICH	NGVD29	2nd	12.60	NAVD88	2nd	3.496	AT THE NORTHWEST END OF THE ROUTE 28 BRIDGE (045-719-043) OVER THE HERRING RIVER, 0.7 MI EAST OF DENNIS-HARWICH TOWN LINE, 4.1 FT SOUTHWEST OF THE SOUTH CORNER OF THE GRANITE END POST, 4.0 FT SOUTH OF THE WEST CORNER OF THE SAME END POST, 1.6 FT NORTH OF THE FACE OF THE GRANITE CURB. RM 1 ...."c" PIN IN MHB AT HIGHWAY STATION 34+50 SOUTH. ELEV 9.828 FT. RM 2 ...."c" PIN IN MHB AT HIGHWAY STATION 34+50 NORTH SIDE. ELEV 8.938 FT.	Yes
☐	17338	4901	HARWICH	NGVD29	2nd	10.575	-	-	-	AT THE SOUTH END OF THE WEST ABUTMENT, AT THE SOUTHWEST CORNER OF THE LOWER COUNTY ROAD BRIDGE OVER THE HERRING RIVER.	No
☐	17337	4900	HARWICH	NGVD29	2nd	11.614	NAVD88	2nd	3.193	EAST ABUTMENT AT THE NORTHEAST CORNER OF THE ROUTE 28 BRIDGE (045-719-043) OVER THE HERRING RIVER, IN WEST HARWICH, BEHIND THE END POST, 26.4 FT NORTH OF THE CENTERLINE OF ROUTE 28, 54.4 FT NORTH OF POLE 438, 178 FT EAST OF BM 10341.	No
☐	17334	559	HARWICH	NAVD88	2nd	15.80	NGVD29	2nd	53.110	PLEASANT LAKE, 147 FT SOUTH OF ROUTE 124, 55.9 FT EAST OF HOUSE, 53.3 FT SOUTHEAST OF POLE 3, 40 FT NORTHWEST OF SHED, 2.5 FT FROM GARAGE NEAR CONCRETE WALK.	Yes
☐	17333	558	HARWICH	NGVD29	2nd	39.750	NAVD88	2nd	5.705	HINCKLEYS POND, AT PUMP HOUSE, ON THE EAST SIDE OF THE PUMP HOUSE, 1060 FT WEST ALONG RAILROAD FROM MIDCAPE HIGHWAY.	Yes
☐	17331	550	HARWICH	NGVD29	2nd	27.830	-	-	-	NOT ON TOP OF BOULDER, PROBABLY DISTURBED. 294 FT EAST OF INTERSECTION OF GREAT WESTERN ROAD AND NH RAILROAD (BOSTON DIVISION), 7.9 FT NORTH OF NORTH RAIL, NORTH OF POWERR POLE 203.	Yes
☐	17330	549	HARWICH	NGVD29	2nd	12.310	-	-	-	871 FT EAST OF THE INTERSECTION OF DEPOT ST AND NH RAILROAD (BOSTON DIVISION), 93.9 FT SOUTH OF SOUTH RAIL.	No
☐	17329	65 P6	HARWICH	NGVD29	2nd	19.090	-	-	-	IN THE SOUTHEAST PART OF TOWN, 1 MI SOUTHEAST OF THE CENTER, ON THE CENTER CHATHAM ROAD, SET FLUSH IN THE DOORSILL ON THE NORTH SIDE OF THE PUMPING STATION. 65-P 6A....MONEL RIVET IN A 18 X 18 X 8 INCH SLAB, THE TOP OF WHICH IS 4 INCHES ABOVE GROUND, 70.2 FT NORTH OF 65-P 6. ELEV 25.55 FT. 65-P 6B....MONEL RIVET SET IN A 4 X 4 X 2.5 FT BOULDER, THE TOP OF WHICH IS 3 INCHES ABOVE GRADE, 265.25 FT NORTHEAST OF 65-P 6. ELEV 20.53 FT. UNDER GARAGE.	Yes
☐	17328	65 P7	HARWICH	NGVD29	2nd	44.230	-	-	-	IN THE SOUTHWEST PART OF TOWN, AT THE HARWICH WATER TANK, SET FLUSH IN THE SOUTH CORNER OF THE CONCRETE FOUNDATION FOR THE RISER PIPE, 12 IN FROM WEST EDGE, 17 IN FROM THE EAST EDGE OF CONCRETE. 65-P 7A....MONEL RIVET IN GRANITE MONUMENT UP 3 INCHES, 104.1 FT SOUTHEAST OF THE SOUTHWEST CORNER OF BARN, 24.8 FT FROM THE CENTERLINE OF ROUTE 28, 195 FT SOUTHEAST OF 65-P 7. ELEV 33.69 FT. 65-P 7B....MONEL RIVET IN GRANITE MONUMENT UP 4 INCHES, 37.4 FT NORTH OF THE CENTERLINE OF ROUTE 28, 150.5 FT SOUTHWEST OF 65-P 7. ELEV 41.79 FT NOT FOUND 11/80.	Yes
☐	5119	M 25W	HARWICH	NGVD29	2nd	17.603	-	-	-	ON THE NORTH SIDE OF LOWER COUNTY ROAD AT THE JUNCTION WITH RIVERSIDE DRIVE, 21.0 FT NORTH OF THE CENTERLINE, 19.1 FT EAST OF THE CENTERLINE OF RIVERSIDE DRIVE, 72.6 FT NORTHWEST OF THE NORTHWEST CORNER OF HOUSE ON EAST SIDE OF RIVERSIDE DRIVE, 59.5 FT NORTHEAST OF THE NORTHEAST CORNER OF HOUSE ON WEST SIDE, 5.2 FT EAST OF POLE 44-27, 2.8 FT SOUTH OF A COUNTY BOUND.	Yes
☐	5118	M 25V	HARWICH	NGVD29	2nd	14.952	-	-	-	ON THE SOUTH SIDE OF LOWER COUNTY ROAD, 21.2 FT SOUTH OF THE CENTER OF THE ROAD, 225.07 FT EAST OF THE EAST END OF WOODEN SECTION OF HERRING RIVER BRIDGE, 40.8 FT SOUTH OF POLE 49/8, 99.5 FT SOUTHWEST OF POLE 49/9, 23.2 FT NORTHEAST OF NORTHEAST CORNER OF GARAGE.	Yes
☐	5117	M 25U	HARWICH	NGVD29	2nd	15.215	-	-	-	ON THE SOUTH SIDE OF LOWER COUNTY ROAD, 15.5 FT SOUTH OF THE CENTER OF THE ROAD, FT WEST OF THE CENTERLINE OF WYNDMERE BLUMS ROAD, 73.6 FT SOUTHWEST OF POLE 49/74, 89.9 FT SOUTHWEST OF SOUTHEAST CORNER OF GARAGE.	Yes
☐	5116	M 25T	HARWICH	NAVD88	2nd	5.45	NGVD29	2nd	18.920	ON THE SOUTH EDGE OF THE SIDEWALK, AT THE INTERSECTION OF ROUTE 28 AND LOWER COUNTY ROAD, 53.3 FT SOUTHEAST OF THE NORTHEAST CORNER OF FIELDSTONE WALL, 79.3 FT NORTHWEST OF NORTHWEST CORNER OF HOUSE, 90.7 FT NORTHEAST OF NORTHEAST CORNER OF SECOND HOUSE.	Yes
☐	5115	M 25S TIDAL 844-7506	HARWICH	NGVD29	2nd	17.390	NAVD88	2nd	4.958	ON THE SOUTHEAST CORNER OF THE INTERSECTION OF ROUTE 28 AND BANK STREET, ABOUT 800 FT EAST OF HARWICHPORT, 87.0 FT EAST OF THE NORTHEAST CORNER OF STORE, 19.8 FT SOUTHEAST OF THE INTERSECTION OF THE CENTERLINES, 45.7 FT SOUTHEAST OF POLE 11/83, 85.2 FT EAST OF POLE 105/51, 32.3 FT WEST OF POLE 105/53.	Yes
☐	5114	M 25Q	HARWICH	NGVD29	2nd	39.216	-	-	-	ON THE WEST SIDE OF BANK STREET, 25 FT WEST OF THE CENTERLINE, ABOUT 0.25 MI SOUTHEAST OF TOWN, 515 FT SOUTHEAST OF PARALLEL STREET, 90 FT SOUTHWEST OF POLE 11/8, 59 FT WEST OF POLE 11/7.	Yes
☐	5113	M 25P	HARWICH	NGVD29	2nd	53.293	-	-	-	ON THE NORTHEAST SIDE OF BANK STREET, 24 FT NORTHEAST OF THE CENTERLINE, OPPOSITE THE END OF PARALLEL STREET, ABOUT ONE EIGHTH MI SOUTHEAST OF THE CENTER OF TOWN, 75 FT NORTHEAST OF THE NORTHEAST CORNER OF THE HOTEL, 99.5 FT SOUTHEAST OF HYDRANT, 10.4 FT SOUTHEAST OF POLE 57/346.	Yes
☐	5112	M 25N	HARWICH	NGVD29	2nd	26.705	-	-	-	WEST HARWICH HOLY TRINITY CATHOLIC CHURCH, 1934 ABOUT 2150 FT EAST OF THE JUNCTION OF ROUTE 28 AND ROUTE 39, ON THE NORTH SIDE OF ROUTE 39, 59.8 FT NORTH OF POLE 57/499, 54.8 FT NORTH OF CONCRETE BOUND WHICH IS ON THE SOUTH SIDE OF ROAD, 55.5 FT WEST OF GUY POLE 57/500, 53.6 FT SOUTH OF SOUTHEAST CORNER OF HOUSE.	Yes
☐	5111	M 25M	HARWICH	NGVD29	2nd	10.5	NAVD88	2nd	2.561	ON THE EAST SIDE OF ROUTE 124, 29.2 FT EAST OF THE CENTERLINE, ABOUT 1000 FT EAST OF THE JUNCTION OF ROUTE 28 AND ROUTE 24, 46.7 FT SOUTH OF POLE 57/490, 86.6 FT NORTH OF POLE 57/489, 9.7 FT NORTHWEST OF 10 IN CEDAR TREE.	Yes
☐	5110	M 25K	HARWICH	NGVD29	2nd	5.556	-	-	-	ON THE NORTH SIDE OF ROUTE 28 IN WEST HARWICH, 24.6 FT NORTH OF THE CENTERLINE, ABOUT 300 FT EAST OF THE HERRING RIVER BRIDGE, 118.5 FT SOUTHWEST OF THE SOUTHWEST CORNER OF THE WEATHERDECK RESTAURANT, 65.5 FT NORTHWEST OF A 24-INCH MAPLE, 49.3 FT EAST OF UTILITY POLE.	Yes
☐	5109	M 25J	HARWICH	NGVD29	2nd	12.224	-	-	-	WEST HARWICH, AT THE SOUTHWEST CORNER OF ROUTE 28 AND RIVERSIDE DRIVE, 80.4 FT NORTHEAST OF THE NORTHEAST CORNER OF A TWO STORY HOUSE ON SOUTHEAST CORNER, 105.7 FT SOUTHWEST OF THE SOUTHEAST CORNER OF A TWO STORY HOUSE ON THE NORTH SIDE, 17 FT WEST OF THE CENTER OF RIVERSIDE DRIVE.	Yes
☐	5108	M 25H	HARWICH	NAVD88	2nd	5.19	NGVD29	2nd	17.856	343 FT EAST OF DENNIS-HARWICH TOWNLINE, ON SOUTH SIDE OF ROUTE 28 (MAIN STREET), 40.8 FT NORTH OF THE NORTHEAST CORNER OF PORCH, 41.7 FT SOUTH OF MHB ON NORTH SIDE OF ROAD, 81.5 FT SOUTH OF SOUTHWEST CORNER OF HOUSE ON NORTH SIDE OF THE ROAD, 54.0 FT WEST OF POLE 414, 51.5 FT EAST OF POLE 415.	Yes
☐	5106	M 25BA TIDAL 844-7505	HARWICH	NAVD88	2nd	4.337	-	-	-	HARWICHPORT, ON THE SOUTH SIDE OF ROUTE 28, 24 FT SOUTH OF THE CENTERLINE, 168 FT WEST OF CENTERLINE OF SNOW INN ROAD, 265 FT EAST OF THE CENTERLINE OF BAY VIEW ROAD, 1.2 FT SOUTH OF WALK, 28.1 FT SOUTHWEST OF CATCH BASIN, 72.2 FT WEST OF POLE 37/41, 35.9 FT NORTHWEST OF THE NORTHEAST CORNER OF HOUSE, 36.5 FT NORTHEAST OF THE NORTHWEST CORNER, 80.5 FT EAST OF POLE	Yes
☐	5100	140 C	HARWICH	NGVD29	2nd	38.170	-	-	-	PLEASANT LAKE, ON THE EAST SIDE OF PLEASANT LAKE AVENUE (ROUTE 24), 29 FT NORTHEAST OF THE CENTERLINE, 0.7 MI NORTH OF THE POST OFFICE, 69.7 FT NORTHWEST OF RAILROAD MILEPOST 87, 63.5 FT SOUTHEAST OF POLE 24/110, 77.5	Yes

MassDOT Benchmarks		
Harwich		
NAVD 88	NGVD 29	Comparison
5.431	19.920	-2.102
15.800	53.110	-1.273
8.706	29.750	-1.187
3.193	11.614	-1.138
9.298	31.640	-1.135
3.496	12.603	-1.133
4.956	17.390	-1.130
2.861	10.500	-1.114
5.109	17.856	-1.094
Average		**-1.124**
Range/2		0.022
		Vertcon
Northeast		-0.883
Southeast		-0.886
Southwest		-0.883
Northwest		-0.876
Average		**-0.882**
Difference between the two solutions		**0.242**

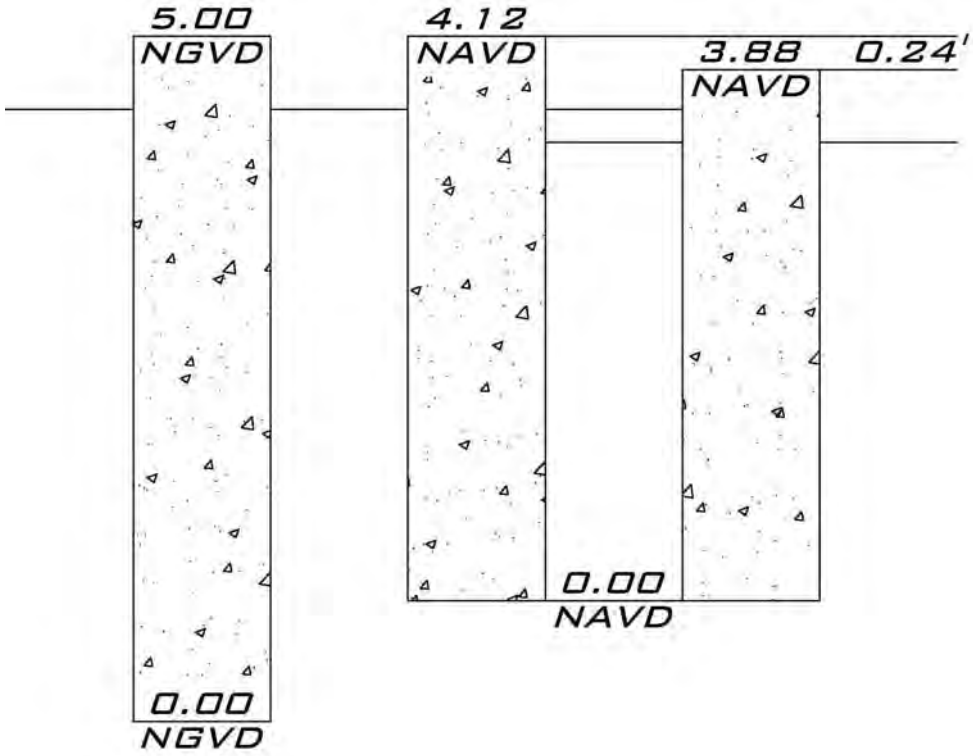
The NAVD benchmarks (in meters) and the NGVD benchmarks (in feet) are compared in feet.

The three records in red have been disregarded. The others match within reason.

The VertCon results have been averaged, the range is minimal.

There is a 0.24’ difference between the two conversions.

Which would you hold?



This is represents the same benchmark in Harwich at different times.

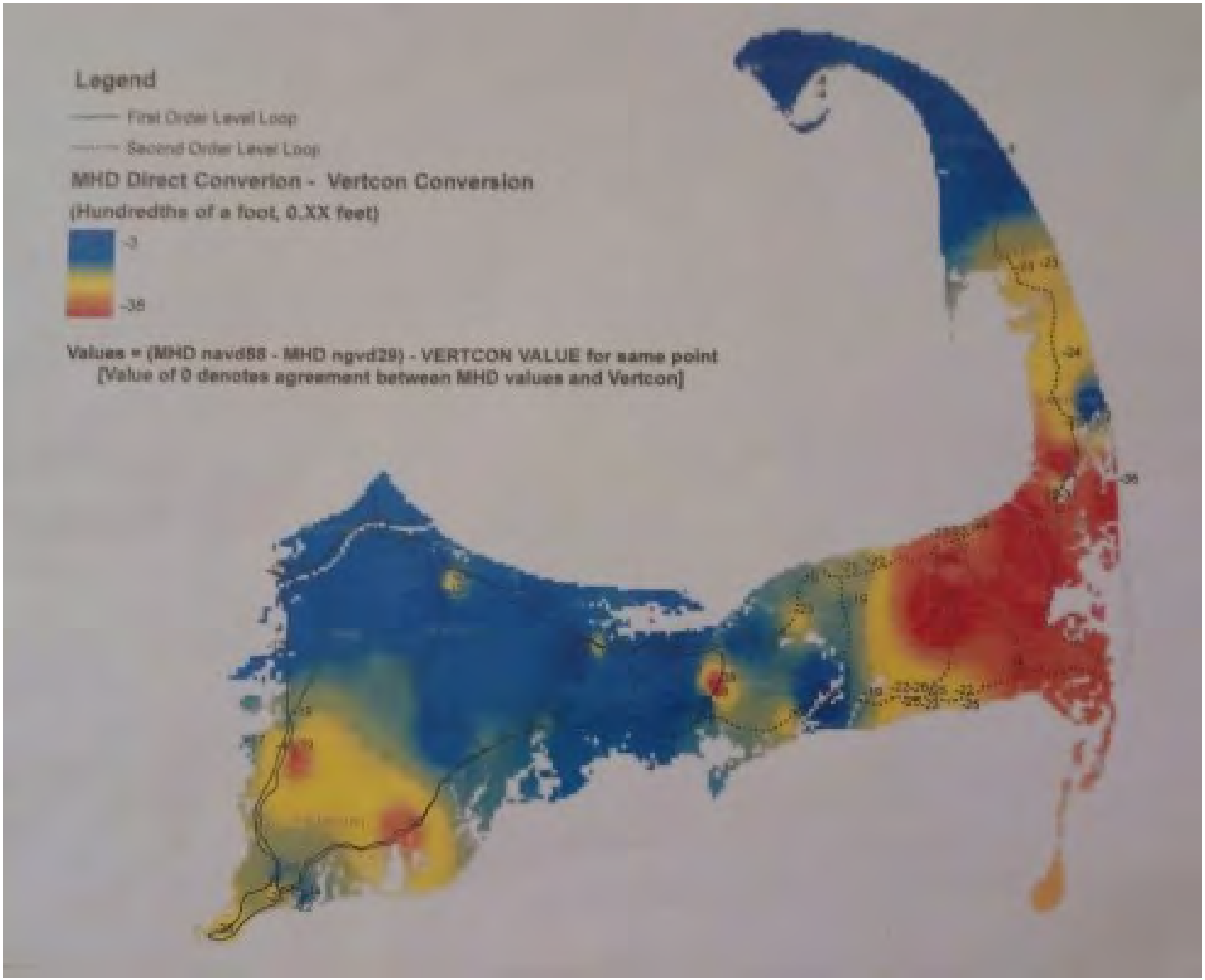
The first benchmark was established at **5.00’ NGVD**.

The second benchmark is the elevation of the first with the VertCon conversion applied to result in **4.12’ NAVD**.

The third benchmark is the actual location of the monument factoring in subsidence, **3.88’ NAVD**.

The relation between NGVD and NAVD is the same, the subsidence caused change to the elevation of the monument.

MassDOT Survey has worked on the conversion from NGVD and NAVD.



The most likely cause for the difference or error in the VertCon model is subsidence.

The following shows the variation between the conversion and the comparison ranging from 0.03’ to 0.38’.

MHD used their level loops to calculate the error when using VertCon.

Local Subsidence

- The NGVD benchmarks were set in the 40's and 50's.
- The NAVD benchmarks were sets in the 90's and 00's.
- There was about 50 years of subsidence between the two sets.
- 0.03' => **0.06'** of subsidence in a century.
- 0.38' => **0.76'** of subsidence in a century.

Velocity

There was a CORS in Chatham until 2002.

The velocity was computed in 2011.

There are some young CORS stations that have computed velocity data.

The information can be found under the Coordinates Section of the CORS Station Page.

CORS Coordinate Page

Decommissioned
2002161

CHT1
CHATHAM 1
Chatham, MA
USA

Site operated by:
USCG

Coordinates

SiteLog
Photographs
Data Availability
Standard Files
Custom Files (UFCORS)

Time Series (short-term)
Time Series (long-term)

Google Map all CORS

Enter SiteID

CORS Home

National Geodetic Survey - CORS

Please choose the coordinate you want to use.

New Coordinates: In IGS08 epoch 2005.00 and NAD 83(2011,MA11,PA11) epoch 2010.00

These coordinates were computed using absolute antenna calibrations and should only be used when processing data with absolute antenna calibrations.

Position and Velocity
Data Sheet for Position at ARP
Data Sheet for Position at ARP and, if available, MON (monument)

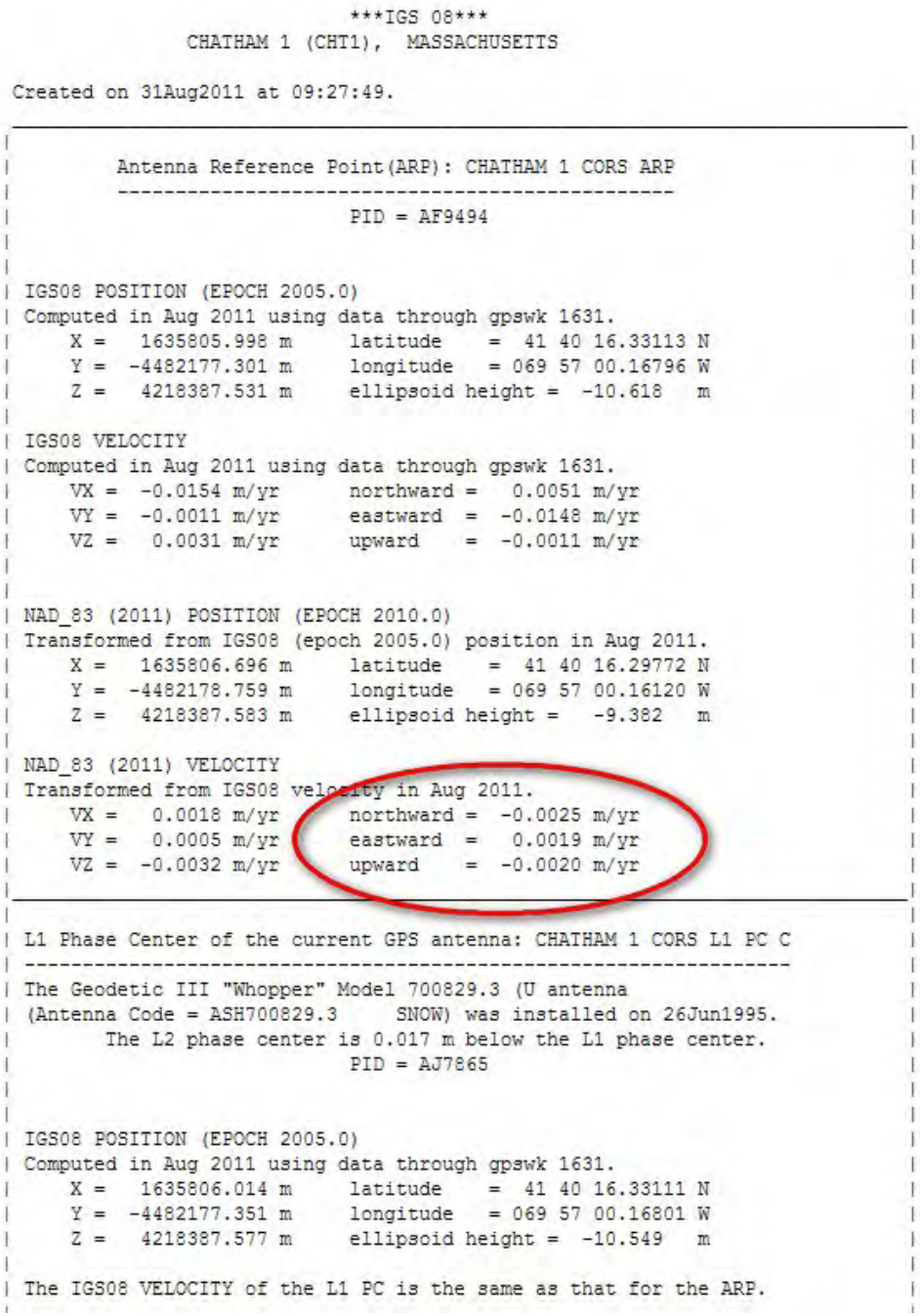
Old Coordinates: In ITRF00 epoch 1997.00 and NAD 83(CORS96,MARP00,PACP00) epoch 2002.00

No longer supported as of September 6, 2011

These coordinates were computed using relative antenna calibrations and should only be used when processing data with relative antenna calibrations.

Position and Velocity

For additional information on the differences between IGS08, NAD 83(2011,MA11,PA11) and ITRF00, NAD 83(CORS96,MARP00, PACP00) consult:
geodesy.noaa.gov/CORS/coords.shtml



```
                        ***IGS 08***
              CHATHAM 1 (CHT1),  MASSACHUSETTS

Created on 31Aug2011 at 09:27:49.

        Antenna Reference Point(ARP): CHATHAM 1 CORS ARP
        ------------------------------------------------
                        PID = AF9494


IGS08 POSITION (EPOCH 2005.0)
Computed in Aug 2011 using data through gpswk 1631.
    X =   1635805.998 m     latitude    =  41 40 16.33113 N
    Y =  -4482177.301 m     longitude   = 069 57 00.16796 W
    Z =   4218387.531 m     ellipsoid height =  -10.618   m

IGS08 VELOCITY
Computed in Aug 2011 using data through gpswk 1631.
    VX =  -0.0154 m/yr      northward =   0.0051 m/yr
    VY =  -0.0011 m/yr      eastward  =  -0.0148 m/yr
    VZ =   0.0031 m/yr      upward    =  -0.0011 m/yr


NAD_83 (2011) POSITION (EPOCH 2010.0)
Transformed from IGS08 (epoch 2005.0) position in Aug 2011.
    X =   1635806.696 m     latitude    =  41 40 16.29772 N
    Y =  -4482178.759 m     longitude   = 069 57 00.16120 W
    Z =   4218387.583 m     ellipsoid height =   -9.382   m

NAD_83 (2011) VELOCITY
Transformed from IGS08 velocity in Aug 2011.
    VX =   0.0018 m/yr      northward =  -0.0025 m/yr
    VY =   0.0005 m/yr      eastward  =   0.0019 m/yr
    VZ =  -0.0032 m/yr      upward    =  -0.0020 m/yr

L1 Phase Center of the current GPS antenna: CHATHAM 1 CORS L1 PC C
------------------------------------------------------------------
The Geodetic III "Whopper" Model 700829.3 (U antenna
(Antenna Code = ASH700829.3     SNOW) was installed on 26Jun1995.
       The L2 phase center is 0.017 m below the L1 phase center.
                        PID = AJ7865


IGS08 POSITION (EPOCH 2005.0)
Computed in Aug 2011 using data through gpswk 1631.
    X =   1635806.014 m     latitude    =  41 40 16.33111 N
    Y =  -4482177.351 m     longitude   = 069 57 00.16801 W
    Z =   4218387.577 m     ellipsoid height =  -10.549   m

The IGS08 VELOCITY of the L1 PC is the same as that for the ARP.
```

Velocity

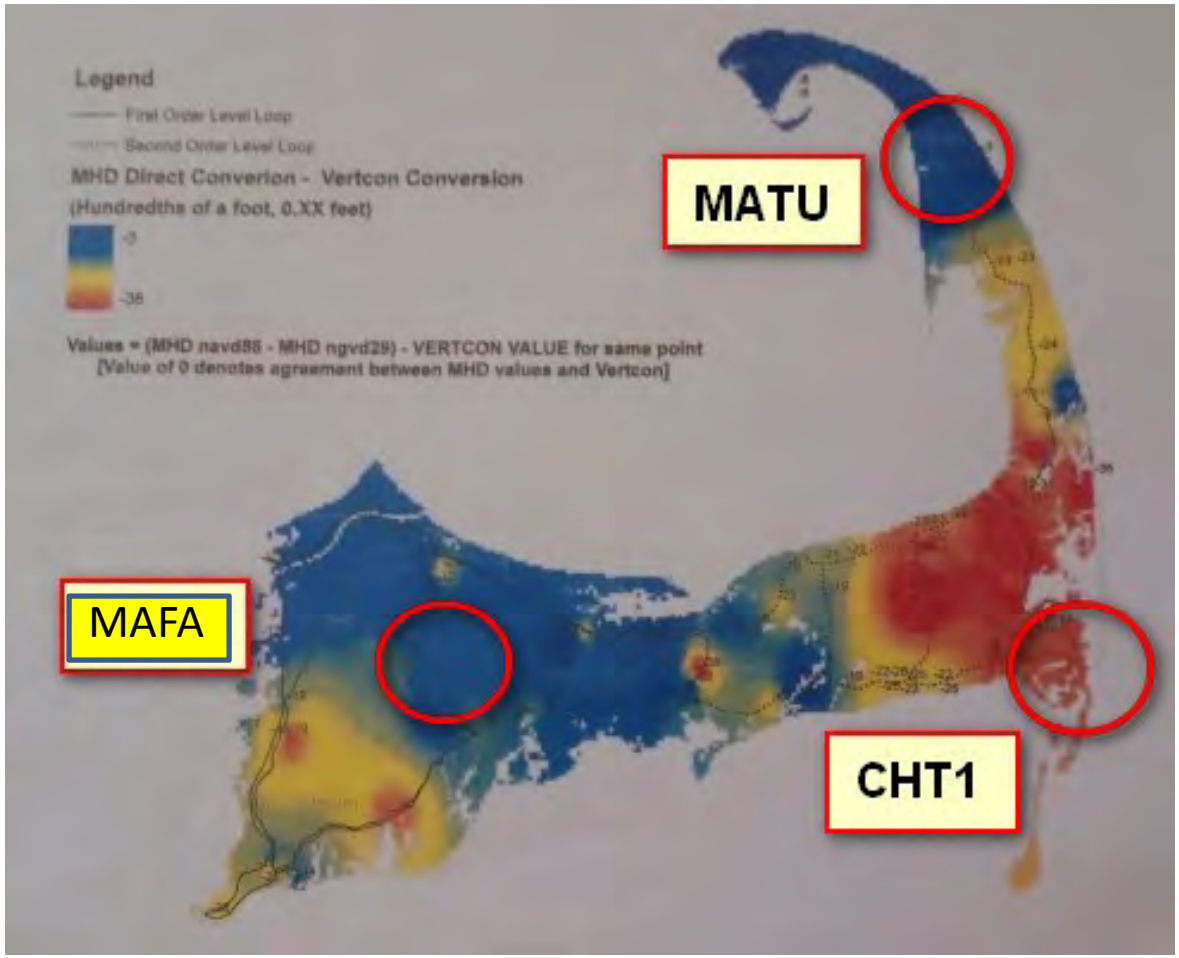
The MassDOT map shows a maximum observed subsidence of about -0.76 feet per century. This converts to **-0.0023 m/yr**.

The station data lists an upward velocity of **-0.0020 m/yr**. This converts to 0.66 feet per century.

Time becomes important. The MassDOT data ranged from the 40's to the 00's. The CORS Station went online in 1995 and was decommissioned in 2002.

The exact rate of subsidence or uplift at a given location cannot be accurately mapped by the CORS network; the guidelines space the stations too far apart.

3 CORS on Cape Cod



CHT1 was decommissioned in 2002. The velocity is historic.

MATU and MAFL were added to the CORS network in 2013.

The two MassDOT CORS stations are on relatively stable ground. The velocities computed for these will not adequately define the more rapid velocities.

The NGS has guidelines to space CORS stations… Cape Cod is now full.

Homemade CORS

This is an old ‘Whopper III’ geodetic antenna. Incidentally it is the same antenna that was used for CHT1.

Old GPS units are readily available or collecting dust in closets and storerooms.

Try to meet the CORS guidelines outlined on the NGS website.

Note: To become an official CORS, there must be a 70 km station separation to other CORS or be for the resolution of an issue in the area.

Guidelines for Establishing and Operating CORS

NOAA's National Geodetic Survey (NGS) invites organizations and individuals to share data from their permanent GPS base stations by including these stations in the National CORS network. Each CORS must meet the specifications described in the **CORS Guidelines (pdf) - Jan 2013**

Joining the Continuously Operating Reference Station (CORS) Network

Key Requirements

- Receiver/Antenna is at least dual frequency (L1 and L2)
- Receiver tracks at least ten satellites above 0 degrees
- Receiver provides L1 C/A-code pseudorange or P-code pseudorange
- Receiver provides L1 and L2 full wavelength carrier phase
- Receiver and Antenna models must use international **codes**
- Antenna and monument must be coupled by an **orienting/leveling device**
- Antenna oriented to TRUE north (**Calculate Magnetic Declination**)
- Antenna has NGS phase center variability model available (**http://www.ngs.noaa.gov/ANTCAL**)
- Equipment metadata including photographs and station log must be provided
  - Photos (**Description**) (**Sample**)
  - Logs (**Blank Log**) (**Log Instructions**) (**Log Checker**)
- Data are freely available for distribution
- Data are recorded on a 30-second or shorter interval
- Provider has on-site Internet access
- Provider maintains all equipment
- Provider agrees to adopt positional coordinates sanctioned by NGS

Status of Future or Proposed CORS

Unofficial CORS…

This GPS antenna does not meet many of the specifications for a CORS. Perhaps one day the station will be updated to be more stable. UHF RTK or Cell Phone RTK can be added. This is a GPS receiver and an obvious upgrade would be to a GNSS receiver.

This allows for the recordation of long data sets. The sets can be uploaded to OPUS, OPUS Projects or used for in-house computations.

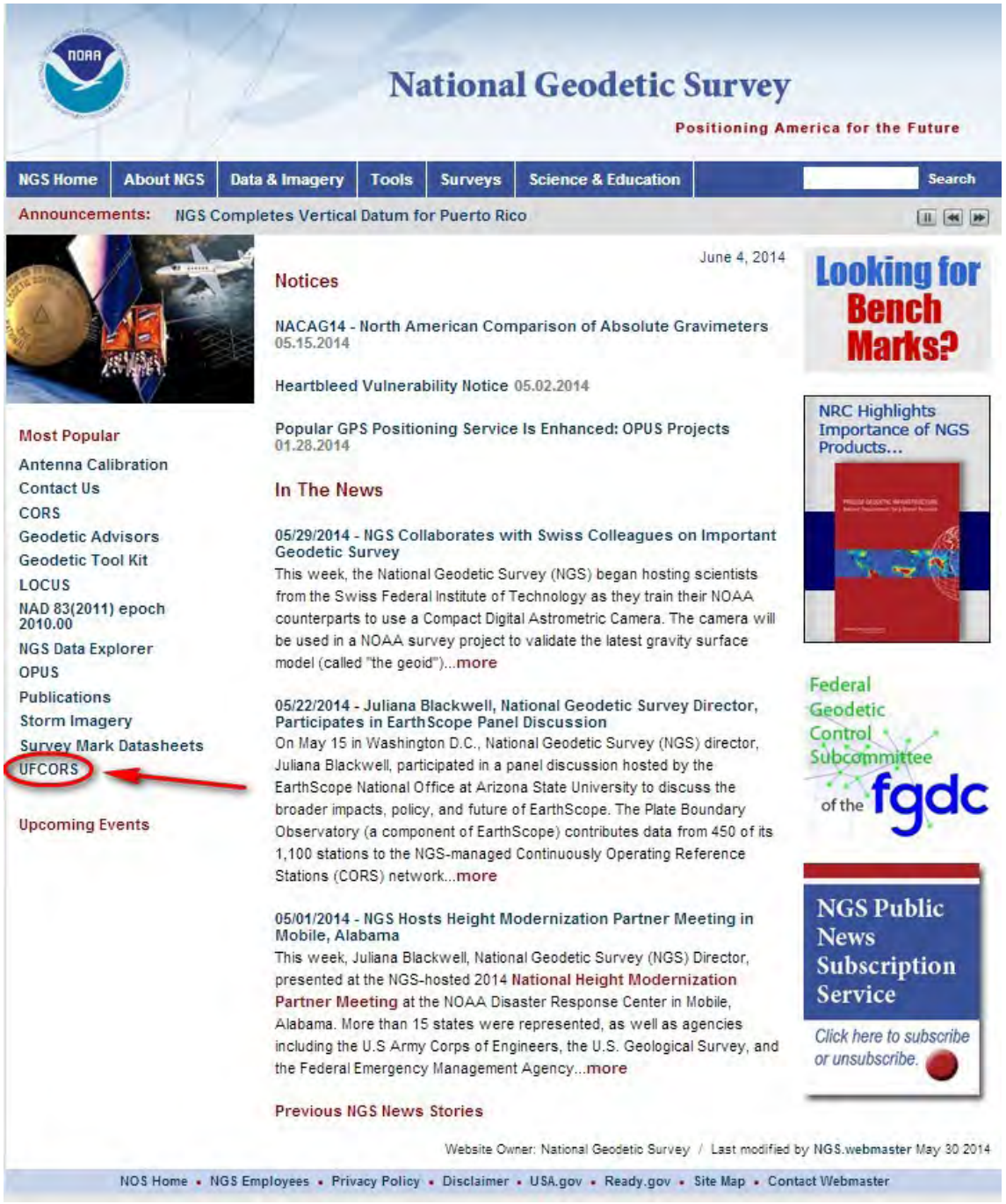
Meeting the guidelines specified in NGS-58 and NGS-59 became substantially easier with this station.

Processing GPS Data

- NGS
- OPUS, OPUS Projects
- Good results
- GPS only (Sorry GNSS)
- Long data sets
- E-mails…

- SELF
- Various software packages
  - TopCon Tools for raw GPS processing
  - Carlson SurvNet for least squares adjustment
  - You choose your own poison.
- Options for more data
  - Total station
  - Leveling
  - Other GPS
- Better output options

Other data sources



You can obtain CORS files and Coordinates from the NGS.

UFCORS is an option for the acquisition of portions of the 24-hour files in the archives.

Fill out the form and within minutes a download will start providing the desired file.

The data can be incorporated into a solution.

Using two static bases to determine a static rover location is better than using one. Add a third for good measure…

Maine Technical Source
Reference Station & Location Chart
Updated November 25, 2013

NA2011 (Geoid 12a)

Static Data Link

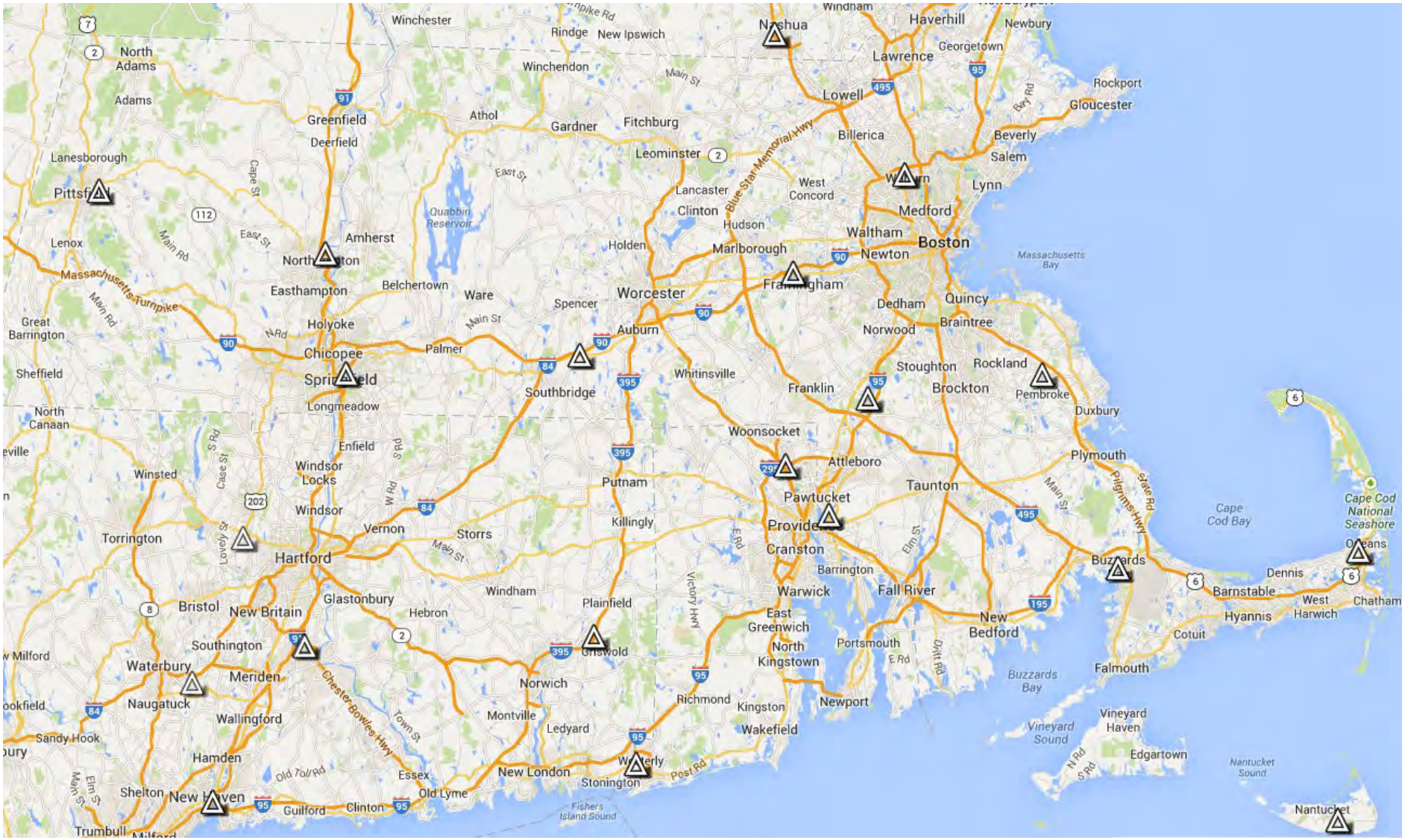
View Maine Technical RTK Base Station Map

Site Name	Location	Site Code	Satellite System	Latitude	Longitude	EL Height
MTS AVON	Avon, CT	AVON	GPS & GLONASS	41° 48' 01.56844" N	72° 50' 11.78363" W	49.358m
MTS GRISWOLD	Griswold, CT	GRIS	GPS & GLONASS	41° 36' 48.41304" N	71° 56' 50.63917" W	27.012m
MTS MIDDLETOWN CHANGED	Middletown, CT	MMTS	GPS Only	41° 35' 26.31794" N	72° 42' 46.40811" W	.553 m
MTS PAWCATUCK	Pawcatuck, CT	PMTS	GPS Only	41° 22' 15.86573" N	71° 50' 23.38142" W	-10.372m
MTS NEW HAVEN	New Haven, CT	NHAV	GPS Only	41° 17' 51.59981" N	72° 54' 43.99658" W	37.840m
MTS BOURNE	Bourne, MA	AMTS	GPS & GLONASS	41° 44' 30.74012" N	70° 37' 02.98137" W	-16.608m
MTS CHARLTON	Charlton, MA	CMTS	GPS & GLONASS	42° 08' 43.42551" N	71° 58' 58.46581" W	229.052m
MTS FOXBORO	Foxboro, MA	XMTS (CORS)	GPS & GLONASS	42° 03' 50.01851" N	71° 15' 01.66913" W	67.953m
MTS FRAMINGHAM GLONASS!	Framingham, MA	FMTS (CORS)	GPS & GLONASS	42° 18' 00.17158" N	71° 26' 30.86597" W	44.044m
MTS HANOVER	Hanover, MA	HMTS	GPS & GLONASS	42° 06' 29.98365" N	70° 48' 38.73075" W	-9.780m
MTS NANTUCKET	Nantucket, MA	IMTS	GPS Only	41° 15' 47.53675" N	70° 03' 40.03347" W	-9.926m
MTS NORTHHAMPTON	Northampton, MA	NORT	GPS & GLONASS	42° 20' 11.14115" N	72° 37' 44.63186" W	23.995m
MTS ORLEANS	Orleans, MA	OMTS	GPS & GLONASS	41° 46' 34.41808" N	70° 00' 26.82194" W	-10.969m
MTS PITTSFIELD	Pittsfield, MA	PITT	GPS & GLONASS	42° 27' 10.78816" N	73° 12' 04.20396" W	292.058m
MTS WOBURN	Woburn, MA	WMTS (CORS)	GPS & GLONASS	42° 29' 00.94877" N	71° 09' 28.65042" W	9.972m
ME DOT AUGUSTA	Augusta, ME	MEOW (ME DOT)	GPS & GLONASS	44° 17' 45.93624" N	69° 44' 43.57001" W	37.313m
ME DOT BANGOR CHANGED	Bangor, ME	MECC (ME DOT)	GPS & GLONASS	44° 49' 33.21000" N	68° 44' 38.60208" W	20.583m
ME DOT GORHAM	Gorham, ME	MEGO (ME DOT)	GPS & GLONASS	43° 40' 52.06776" N	70° 27' 03.72437" W	89.961m
MTS KENNEBUNK	Kennebunk, ME	KENN	GPS & GLONASS	43° 23' 25.00657" N	70° 35' 49.77857" W	30.714m
MTS LEWISTON	Lewiston, ME	LMTS	GPS & GLONASS	44° 04' 01.50563" N	70° 11' 20.29030" W	66.528m
ME DOT S. Paris	S. Paris, ME	MESP (ME DOT)	GPS & GLONASS	44° 13' 06.19617" N	70° 30' 47.10740" W	105.463m
MTS S. BERWICK GLONASS!	South Berwick, ME	BMTS	GPS & GLONASS	43° 14' 05.59468" N	70° 48' 35.14784" W	21.928m
ME DOT WALDO	Waldo, ME	MEWA (ME DOT)	GPS & GLONASS	44° 27' 15.19284" N	69° 05' 49.48920" W	50.696m
MTS YARMOUTH	Yarmouth, ME	YMTS (CORS)	GPS & GLONASS	43° 47' 54.60868" N	70° 11' 20.29744" W	14.066m
MTS NASHUA GLONASS!	Nashua, NH	NMTS	GPS & GLONASS	42° 44' 50.13985" N	71° 29' 21.54887" W	34.881m
MTS TILTON	Tilton, NH	TMTS	GPS & GLONASS	43° 27' 50.81581" N	71° 33' 31.85207" W	141.805m
MTS LINCOLN GLONASS!	Lincoln, RI	LINC	GPS & GLONASS	41° 56' 12.38979" N	71° 27' 38.59049" W	75.427m
MTS RUMFORD	Rumford, RI	RUMF	GPS & GLONASS	41° 50' 32.12361" N	71° 21' 00.42861" W	-3.053m
ME DOT FAIRFIELD New	Fairfield, ME	MEJD	GPS & GLONASS	44° 36' 29.69633" N	69° 35' 59.54946" W	55.957m
MTS SPRINGFIELD	Sprinfield, MA	SPRI	GPS & GLONASS	42° 06' 34.83676" N	72° 34' 35.58212" W	48.532m

Private CORS stations (for fee and for free) can be found.

MTS charges fees for their RTK Network and provides their static data free of charge.

The additional CORS data can be helpful when geometry is a concern. At the moment, the MassDOT CORS Station on Nantucket is not in operation. The use of the two CORS on Cape Cod combined with the MTS CORS on Nantucket will provide a better geometry and therefore (hopefully / typically / usually / sometimes) a better solution.



U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
National Flood Insurance Program

ELEVATION CERTIFICATE

Important: Read the instructions on pages 1–9.

OMB No. 1660-0008
Expiration Date: July 31, 2015

SECTION A – PROPERTY INFORMATION

FOR INSURANCE COMPANY USE

A1. Building Owner's Name — Policy Number:

A2. Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No. — Company NAIC Number:

City State ZIP Code

A3. Property Description (Lot and Block Numbers, Tax Parcel Number, Legal Description, etc.)

A4. Building Use (e.g., Residential, Non-Residential, Addition, Accessory, etc.) ____

A5. Latitude/Longitude: Lat. ____ Long. ____ Horizontal Datum: ☐ NAD 1927 ☐ NAD 1983

A6. Attach at least 2 photographs of the building if the Certificate is being used to obtain flood insurance.

A7. Building Diagram Number ____

A8. For a building with a crawlspace or enclosure(s):
- a) Square footage of crawlspace or enclosure(s) ____ sq ft
- b) Number of permanent flood openings in the crawlspace or enclosure(s) within 1.0 foot above adjacent grade ____
- c) Total net area of flood openings in A8.b ____ sq in
- d) Engineered flood openings? ☐ Yes ☐ No

A9. For a building with an attached garage:
- a) Square footage of attached garage ____ sq ft
- b) Number of permanent flood openings in the attached garage within 1.0 foot above adjacent grade ____
- c) Total net area of flood openings in A9.b ____ sq in
- d) Engineered flood openings? ☐ Yes ☐ No

SECTION B – FLOOD INSURANCE RATE MAP (FIRM) INFORMATION

B1. NFIP Community Name & Community Number	B2. County Name	B3. State

B4. Map/Panel Number	B5. Suffix	B6. FIRM Index Date	B7. FIRM Panel Effective/Revised Date	B8. Flood Zone(s)	B9. Base Flood Elevation(s) (Zone AO, use base flood depth)

B10. Indicate the source of the Base Flood Elevation (BFE) data or base flood depth entered in Item B9.
☐ FIS Profile ☐ FIRM ☐ Community Determined ☐ Other/Source: ____

B11. Indicate elevation datum used for BFE in Item B9: ☐ NGVD 1929 ☐ NAVD 1988 ☐ Other/Source: ____

B12. Is the building located in a Coastal Barrier Resources System (CBRS) area or Otherwise Protected Area (OPA)? ☐ Yes ☐ No
Designation Date: ____ ☐ CBRS ☐ OPA

SECTION C – BUILDING ELEVATION INFORMATION (SURVEY REQUIRED)

C1. Building elevations are based on: ☐ Construction Drawings* ☐ Building Under Construction* ☐ Finished Construction
*A new Elevation Certificate will be required when construction of the building is complete.

C2. Elevations – Zones A1–A30, AE, AH, A (with BFE), VE, V1–V30, V (with BFE), AR, AR/A, AR/AE, AR/A1–A30, AR/AH, AR/AO. Complete Items C2.a–h below according to the building diagram specified in Item A7. In Puerto Rico only, enter meters.

Benchmark Utilized: ____ Vertical Datum: ____

Indicate elevation datum used for the elevations in items a) through h) below. ☐ NGVD 1929 ☐ NAVD 1988 ☐ Other/Source: ____

Datum used for building elevations must be the same as that used for the BFE.

		Check the measurement used.
a) Top of bottom floor (including basement, crawlspace, or enclosure floor)	____.____	☐ feet ☐ meters
b) Top of the next higher floor	____.____	☐ feet ☐ meters
c) Bottom of the lowest horizontal structural member (V Zones only)	____.____	☐ feet ☐ meters
d) Attached garage (top of slab)	____.____	☐ feet ☐ meters
e) Lowest elevation of machinery or equipment servicing the building (Describe type of equipment and location in Comments)	____.____	☐ feet ☐ meters
f) Lowest adjacent (finished) grade next to building (LAG)	____.____	☐ feet ☐ meters
g) Highest adjacent (finished) grade next to building (HAG)	____.____	☐ feet ☐ meters
h) Lowest adjacent grade at lowest elevation of deck or stairs, including structural support	____.____	☐ feet ☐ meters

SECTION D – SURVEYOR, ENGINEER, OR ARCHITECT CERTIFICATION

This certification is to be signed and sealed by a land surveyor, engineer, or architect authorized by law to certify elevation information. *I certify that the information on this Certificate represents my best efforts to interpret the data available. I understand that any false statement may be punishable by fine or imprisonment under 18 U.S. Code, Section 1001.*

☐ Check here if comments are provided on back of form.
☐ Check here if attachments.

Were latitude and longitude in Section A provided by a licensed land surveyor? ☐ Yes ☐ No

PLACE SEAL HERE

Certifier's Name License Number

Title Company Name

Address City State ZIP Code

Signature Date Telephone

FEMA Form 086-0-33 (7/12) See reverse side for continuation. Replaces all previous editions.

Most of the form is relatively straight forward.

The building diagram often provides a reason to reconsider.

Even though the form provides one the ability to produce data on different datums, use **one**.

The elevations are fairly straight forward.
I have two questions: Window Wells (Lowest adjacent grade) and Electric Meters (attached and detached, lowest elevation of machinery or equipment servicing the building).

ELEVATION CERTIFICATE, page 2

IMPORTANT: In these spaces, copy the corresponding information from Section A.	FOR INSURANCE COMPANY USE
Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No.	Policy Number:
City State ZIP Code	Company NAIC Number:

SECTION D – SURVEYOR, ENGINEER, OR ARCHITECT CERTIFICATION (CONTINUED)

Copy both sides of this Elevation Certificate for (1) community official, (2) insurance agent/company, and (3) building owner.

Comments

Signature Date

SECTION E – BUILDING ELEVATION INFORMATION (SURVEY NOT REQUIRED) FOR ZONE AO AND ZONE A (WITHOUT BFE)

For Zones AO and A (without BFE), complete Items E1–E5. If the Certificate is intended to support a LOMA or LOMR-F request, complete Sections A, B, and C. For Items E1–E4, use natural grade, if available. Check the measurement used. In Puerto Rico only, enter meters.

E1. Provide elevation information for the following and check the appropriate boxes to show whether the elevation is above or below the highest adjacent grade (HAG) and the lowest adjacent grade (LAG).
a) Top of bottom floor (including basement, crawlspace, or enclosure) is _____.____ ☐ feet ☐ meters ☐ above or ☐ below the HAG.
b) Top of bottom floor (including basement, crawlspace, or enclosure) is _____.____ ☐ feet ☐ meters ☐ above or ☐ below the LAG.

E2. For Building Diagrams 6–9 with permanent flood openings provided in Section A Items 8 and/or 9 (see pages 8–9 of instructions), the next higher floor (elevation C2.b in the diagrams) of the building is _____.____ ☐ feet ☐ meters ☐ above or ☐ below the HAG.

E3. Attached garage (top of slab) is _____.____ ☐ feet ☐ meters ☐ above or ☐ below the HAG.

E4. Top of platform of machinery and/or equipment servicing the building is _____.____ ☐ feet ☐ meters ☐ above or ☐ below the HAG.

E5. Zone AO only: If no flood depth number is available, is the top of the bottom floor elevated in accordance with the community's floodplain management ordinance? ☐ Yes ☐ No ☐ Unknown. The local official must certify this information in Section G.

SECTION F – PROPERTY OWNER (OR OWNER'S REPRESENTATIVE) CERTIFICATION

The property owner or owner's authorized representative who completes Sections A, B, and E for Zone A (without a FEMA-issued or community-issued BFE) or Zone AO must sign here. The statements in Sections A, B, and E are correct to the best of my knowledge.

Property Owner's or Owner's Authorized Representative's Name

Address City State ZIP Code

Signature Date Telephone

Comments

☐ Check here if attachments.

SECTION G – COMMUNITY INFORMATION (OPTIONAL)

The local official who is authorized by law or ordinance to administer the community's floodplain management ordinance can complete Sections A, B, C (or E), and G of this Elevation Certificate. Complete the applicable item(s) and sign below. Check the measurement used in Items G8–G10. In Puerto Rico only, enter meters.

G1. ☐ The information in Section C was taken from other documentation that has been signed and sealed by a licensed surveyor, engineer, or architect who is authorized by law to certify elevation information. (Indicate the source and date of the elevation data in the Comments area below.)

G2. ☐ A community official completed Section E for a building located in Zone A (without a FEMA-issued or community-issued BFE) or Zone AO.

G3. ☐ The following information (Items G4–G10) is provided for community floodplain management purposes.

G4. Permit Number	G5. Date Permit Issued	G6. Date Certificate Of Compliance/Occupancy Issued

G7. This permit has been issued for: ☐ New Construction ☐ Substantial Improvement

G8. Elevation of as-built lowest floor (including basement) of the building: _____.____ ☐ feet ☐ meters Datum _____

G9. BFE or (in Zone AO) depth of flooding at the building site: _____.____ ☐ feet ☐ meters Datum _____

G10. Community's design flood elevation: _____.____ ☐ feet ☐ meters Datum _____

Local Official's Name Title

Community Name Telephone

Signature Date

Comments

☐ Check here if attachments.

FEMA Form 086-0-33 (7/12) Replaces all previous editions.

The comments section is too small for my typical comments. I usually skip page 2.

ELEVATION CERTIFICATE, page 3

Building Photographs

See Instructions for Item A6

IMPORTANT: In these spaces, copy the corresponding information from Section A.

Building Street Address (including Apt., Unit, Suite, and/or Bldg. No.) or P.O. Route and Box No.	FOR INSURANCE COMPANY USE Policy Number:
City State ZIP Code	Company NAIC Number:

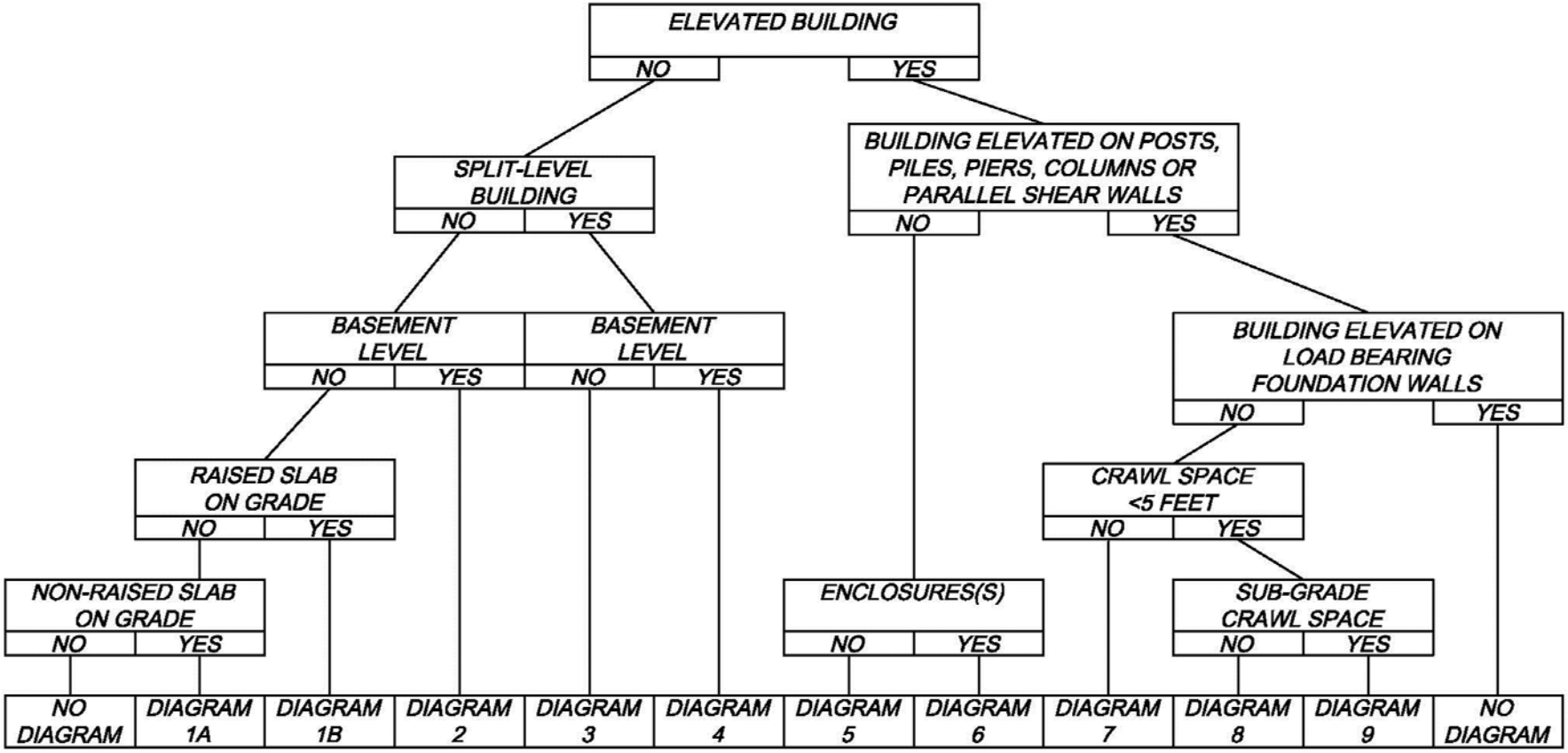
If using the Elevation Certificate to obtain NFIP flood insurance, affix at least 2 building photographs below according to the instructions for Item A6. Identify all photographs with date taken; "Front View" and "Rear View"; and, if required, "Right Side View" and "Left Side View." When applicable, photographs must show the foundation with representative examples of the flood openings or vents, as indicated in Section A8. If submitting more photographs than will fit on this page, use the Continuation Page.

Building photographs must be dated.

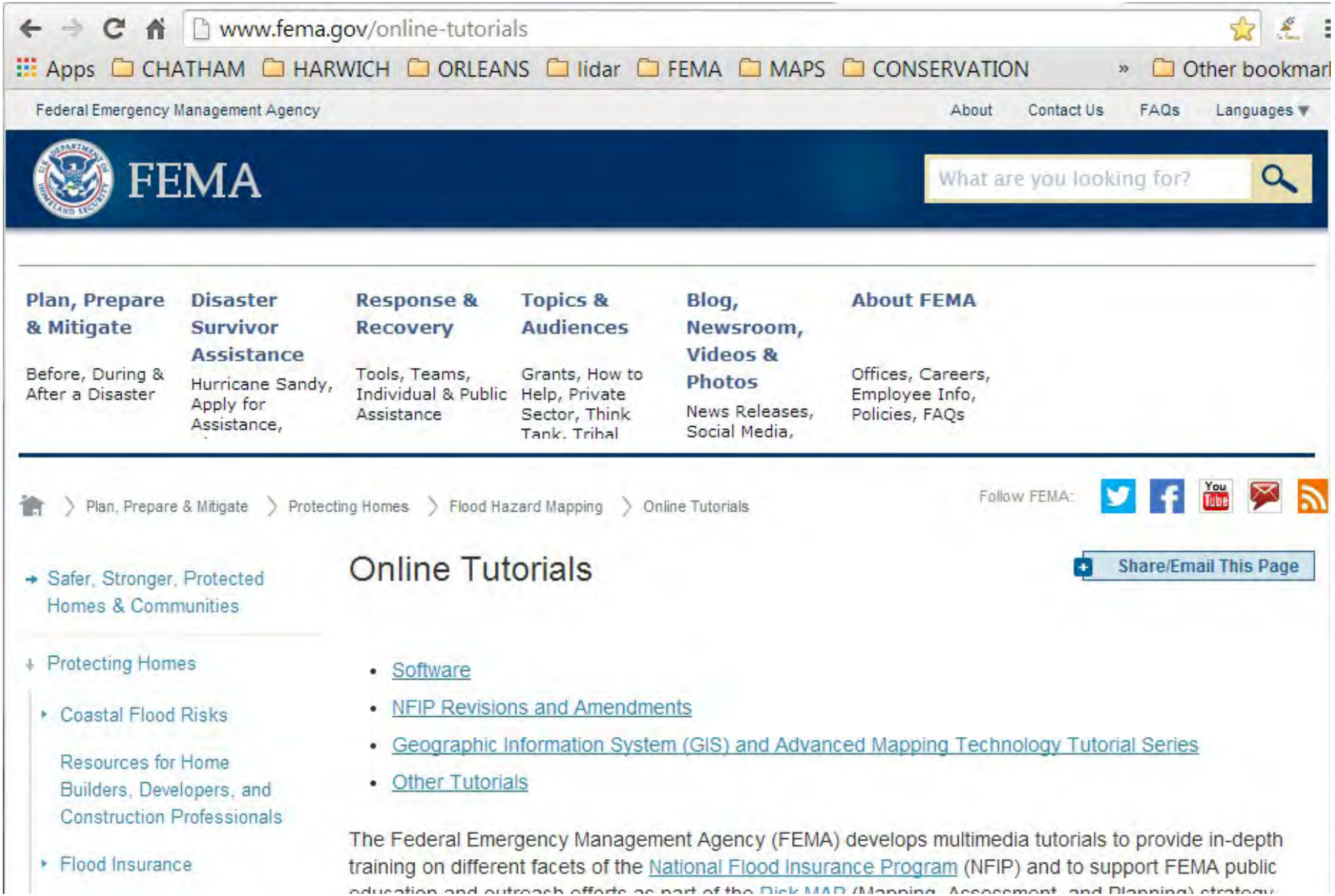
Comments

- The basis of the Latitude and Longitude.
- Describe the benchmark used, especially if GPS is used.
- Notes and photographs of the vents, if any.
- Photographs of the lowest machinery or equipment servicing the building.
- Document anything else that comes to mind.

BUILDING DIAGRAM FLOW CHART



FEMA TUTORIALS



FEMA

Electronic Letter of Map Amendment (eLOMA)

What is eLOMA?

The Federal Emergency Management Agency (FEMA) has designed an interactive online determination tool for MT-1 requests called electronic Letter of Map Amendment (eLOMA). The eLOMA is a web-based application within the Mapping Information Platform (MIP) that provides Licensed Professionals (LP) and Certified Professionals (CP) with a system to submit simple Letter of Map Amendment (LOMA) requests to FEMA. This tool is designed to make a determination based on the information submitted by LPs and CPs, allowing them to generate a determination from FEMA in minutes. The initial release of eLOMA will enable LPs and CPs to make requests for existing single residential structures or properties, provided no fill has been placed to raise the elevations of the structure or property. Approximately half of the LOMAs processed annually (about 29,000 cases) meet the requirements of eLOMA.

What are the advantages of eLOMA?

The eLOMA was designed to facilitate the LOMA process. Historically, because of manual processing, obtaining a LOMA took up to 60 days, provided all required documentation was on file. Using eLOMA, LPs and CPs can receive a determination in the time that it takes to enter the required information online.

How does eLOMA differ from the traditional LOMA process?

A LOMA is a letter from FEMA stating that an existing structure or parcel of land that has not been elevated by the placement of fill is not expected to be inundated by the 1-percent-annual-chance flood (the base flood). To receive an eLOMA, LPs and CPs must register on the MIP to establish an account. Once registered, they will be able to enter property-specific information that they have certified as accurate, as well as data taken from FEMA's Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) reports. LPs and CPs should refer to FIS reports because the Base Flood Elevations (BFEs) are not always found on the FIRMs; the BFE data in the FIS report is generally more accurate. The eLOMA online service will then make a determination based on the submitted information. LPs and CPs will then be able to print a copy once the request is processed. An eLOMA document will serve the same functions as a standard LOMA. The only difference between the two is that the online determination is made automatically with standard checks instead of the lengthier manual review used in traditional LOMA processing. In addition, eLOMA does not replace the LOMA procedure. The eLOMA determination tool is an optional process applicable to only the most basic LOMA requests. Currently, there is no charge to receive a LOMA, and eLOMAs also will be available to LPs and CPs at no cost.

How does eLOMA create determinations through the MIP?

A surveyor or engineer must set up an account through the MIP using individual license certification information. Once the LP or CP registers on the MIP, he or she can log into eLOMA. Once logged in, he or she will be given the option to create a new application or resume a previously saved application. The LP or CP will be asked to submit certified elevations. The eLOMA will make a comparison of the submitted BFE with the submitted Lowest Adjacent Grade (LAG) or Low Lot Elevation (LLE) and provide an instant determination if the application has not been selected for FEMA audit. For quality purposes, eLOMA will ensure that all required information has been entered. If the application is selected for FEMA audit, the LP or CP will receive instructions for submitting their application materials. If the application is approved, the LP or CP will receive notification that they can login and print the determination. If the application is rejected, the LOMA will be completed by FEMA using the standard, manual MT-1 process and the LP or CP will be audited again after his or her next submittal. After a successful audit, the LP or CP will be able to generate eLOMA determinations online. However, he or she will still be subject to random audits.

What is the future of eLOMA?

FEMA will be closely monitoring the progress of eLOMA to consider expanding its capabilities to include:

- Offering broader application requests
- Expanding the use of eLOMA to include additional users
- Adjusting audit frequency as needed

How to register to become an eLOMA licensed professional

Fill out the *eLOMA Registration Form* located at https://hazards.fema.gov and send it to the eLOMA Coordinator. Instructions are provided on the form. Once your request for eLOMA access has been received, it will be reviewed to ensure that you are eligible to use the eLOMA application. If your request is approved you will receive an e-mail with your login information (username and password). Your username and password will allow you to access the eLOMA application through the MIP.

OUTDATED!

eLOMC

Requires registration

Expect an audit. (It’s not that big a deal.)

Expedites the process.

The Online LOMC request tool is the web-based version of the paper MT-1 form. You may request the following determinations from FEMA online:

Letters of Map Amendment (LOMAs) – Typically, a LOMA is issued when the scale of the FIRM does not allow for small areas of natural high ground to be shown outside the SFHA
Conditional Letter of Map Amendment (CLOMA) – A letter from FEMA stating a proposed structure that is not to be elevated by fill (natural grade) would not be inundated by the base flood if built as proposed
Letters of Map Revision based on Fill (LOMR-F) – A LOMR-F is similar to a LOMA, but instead of being based on natural ground elevations, the property or structure has been elevated by fill in order to elevate it above the flood elevation
Conditional Letter of Map Revision-Fill (CLOMR-F) – A letter from FEMA stating a parcel of land or proposed structure that will be elevated by fill would not be inundated by the base flood if fill is placed on the parcel as proposed or the structure is built as proposed
Letters of Map Revision (LOMRs) – A LOMR is an official revision to an effective FIRM map that may change flood insurance risk zones, floodplain and/or floodway boundary delineations, plain metric features, and/or BFE. Unlike LOMAs and LOMR-Fs, a LOMR usually results in reprinting a portion of a FIRM
Conditional Letter of Map Revision (CLOMR) – A CLOMR is a letter from FEMA's stating a proposed project that would, upon construction, affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway, the effective BFE or SFHA

The forms are government forms.

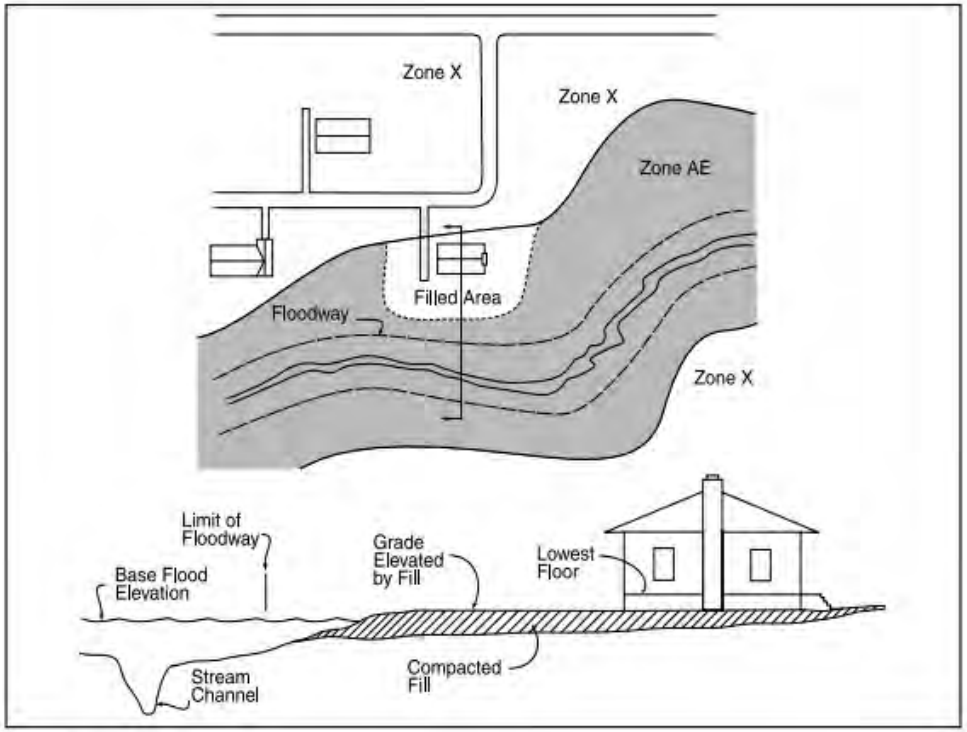
Conditional Letters of Map Amendment and Conditional Letters of Map Revision are typically required prior to the issuance of a building permit.

Some local regulations prohibit fill within the flood plain. Fill is never that easy, but don't worry, there is a technical bulletin that can help.

Technical Bulletin 10-01

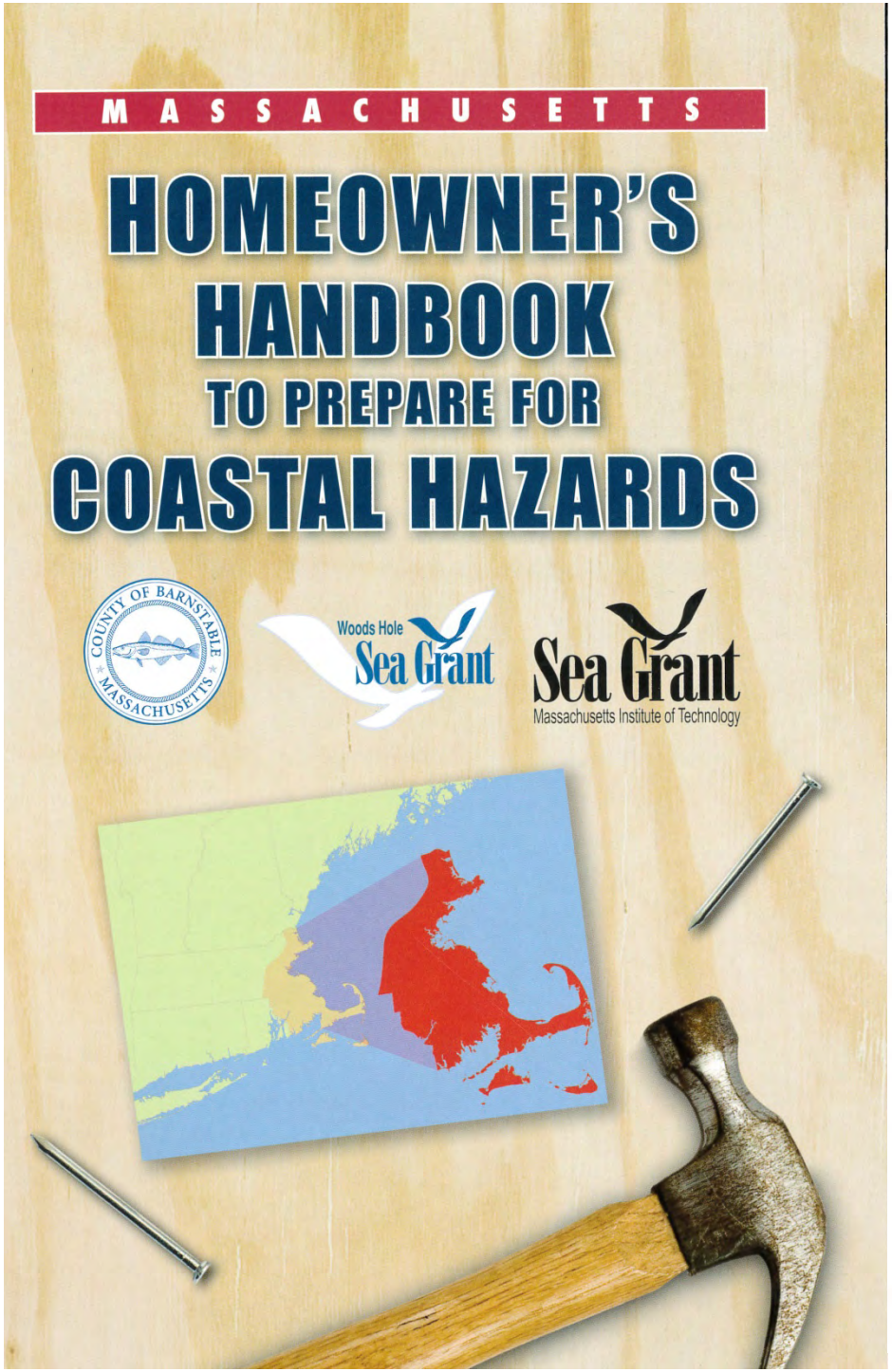
Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding

in accordance with the
National Flood Insurance Program



Federal Emergency Management Agency
Mitigation Directorate

FIA-TB-10
(5/01)



Be on the lookout for other resources. They are out there.

Foundations in Coastal Areas

FEMA

NAHB RESEARCH CENTER

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION FEMA 499/August 2005 *Technical Fact Sheet No. 11*

Purpose: To describe foundation types suitable for coastal environments.

Key Issues

- Foundations in coastal areas must elevate buildings above the Base Flood Elevation (BFE), while withstanding flood forces, high winds, scour and erosion, and floating debris.
- Foundations used for inland construction are generally not suitable for coastal construction.
- Deeply embedded pile or column foundations are required for many coastal areas; in other coastal areas, they are recommended – instead of solid wall, crawlspace, slab, or other shallow foundations that can be undermined easily. ("Deeply embedded" means sufficient penetration into the ground to accommodate storm-induced scour and erosion and to resist all design vertical and lateral loads without structural damage.)
- Areas below elevated buildings in V zones must be "free of obstructions" that can transfer flood loads to the foundation and building (see Fact Sheet No. 27).

Storm surge and waves overtopping a barrier island during Hurricane Frederic.

Foundation Design Criteria

All foundations for buildings in flood hazard areas must be constructed with flood-damage-resistant materials (see Fact Sheet No. 8) and must do two things in addition to meeting the requirements for conventional construction: (1) elevate the building above the BFE, and (2) prevent flotation, collapse, and lateral movement of the building, resulting from loads and conditions during the design flood event (in coastal areas, these loads and conditions include inundation by fast-moving water, breaking waves, floating debris, erosion, and high winds).

Because the most hazardous coastal areas are subject to erosion and extreme flood loads, ***the only practical way to perform these two functions is to elevate a building on a deeply embedded and "open" (i.e., pile or column) foundation***. This approach resists storm-induced erosion and scour, and it minimizes the foundation surface area subject to lateral flood loads – it is required by the National Flood Insurance Program (NFIP) in V zones (even when the ground elevation lies above the BFE) and is recommended for coastal A zones. However, even a deeply embedded open pile foundation will not prevent eventual undermining and loss due to long-term erosion (see Fact Sheet No. 7).

Performance of Various Foundation Types in Coastal Areas

There are many ways to elevate buildings above the BFE: fill, slab-on-grade, crawlspace, stemwall, solid wall, pier (column), and pile. Not all of these are suitable for coastal areas. In fact, several of them are prohibited in V zones