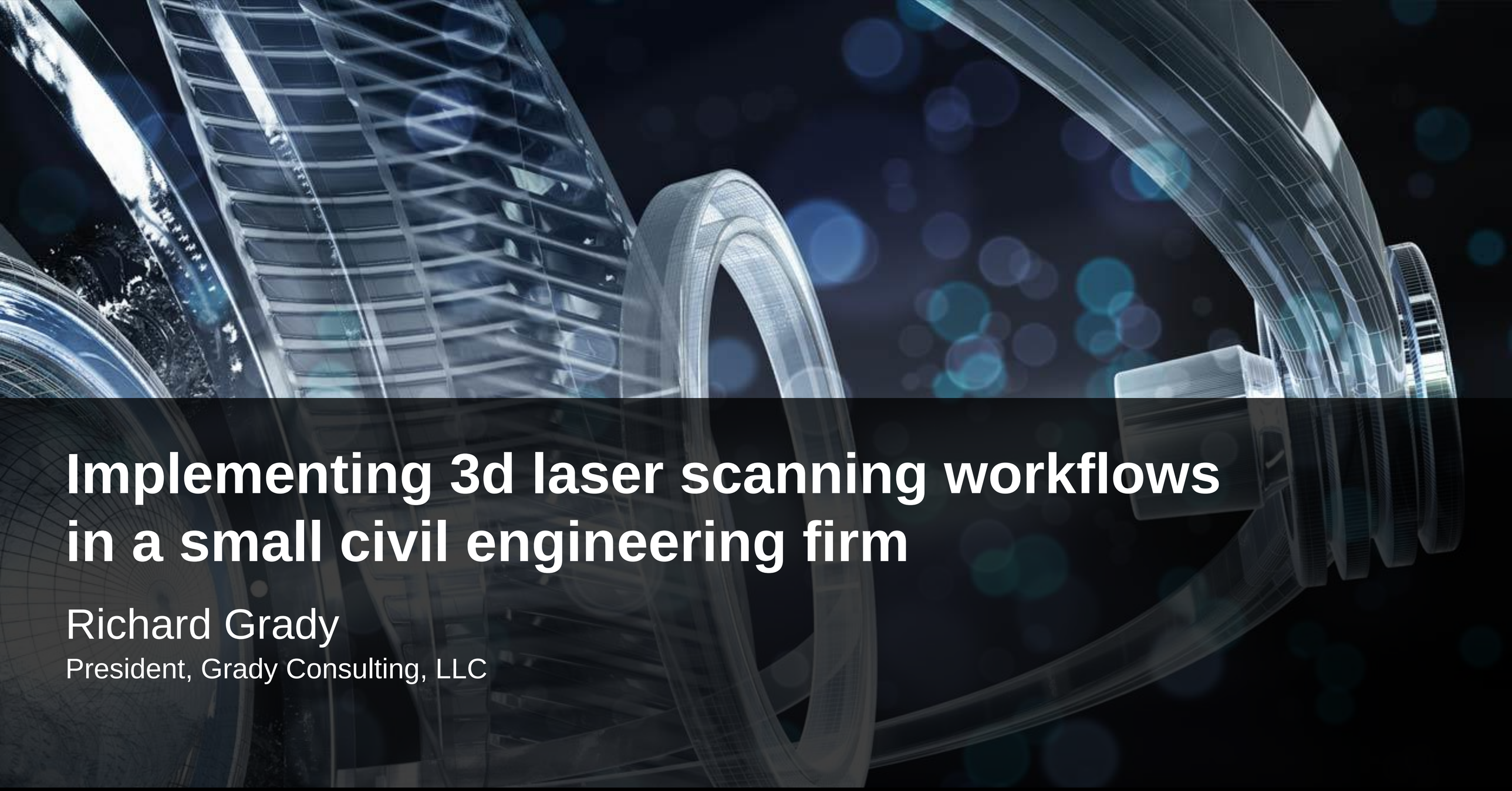


Implementing 3d laser scanning workflows in a small civil engineering firm

Richard Grady

President, Grady Consulting, LLC

Class Summary

- Grady Consulting is a small civil engineering company based in New England with special expertise in designing septic systems, including septic modifications and repairs, mostly for residential clients. In 2010, we added a Leica ScanStation C10 and Leica HDS software to our tool kit, plugging these tools directly into our septic system engineering process. This presentation will describe our field and office workflows as well as project benefits of using laser scanning for our everyday projects. Topics also include scanning capability as part of the company's service offering, activities to expand the company's services to new applications, and specific job examples.

Learning Objectives

At the end of this class, you will be able to:

- Decide whether 3d laser scanning is right for your firm,
- Decide whether purchasing or partnering with an outside provider is more beneficial,
- Avoid some of our implementation issues, and
- Understand the correlation between the Leica HDS software and AutoCAD

GRADY CONSULTING, L.L.C.

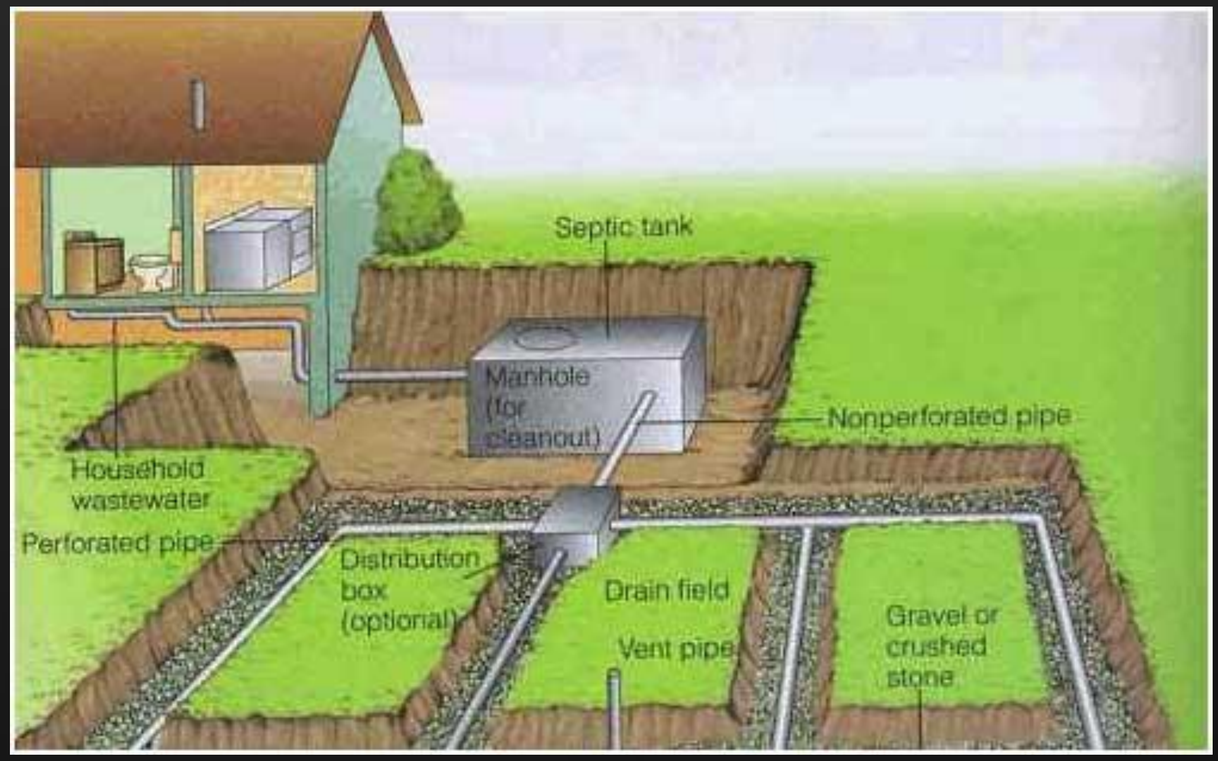
71 Evergreen Street, Kingston, MA 02364
(781) 585-2300
www.GradyConsulting.com

- Family owned & operated professional civil engineering company serving Eastern Massachusetts since 1998
- Civil Engineering Solutions
  - Site development
  - Construction
  - Septic system plans
  - Title V inspections
  - Commercial site plans and subdivision design

What Is A Septic System?

On-site sewage disposal system where no municipal sewer system is available.

- Septic tank for solids removal
- Distribution Box
- Leaching Facility



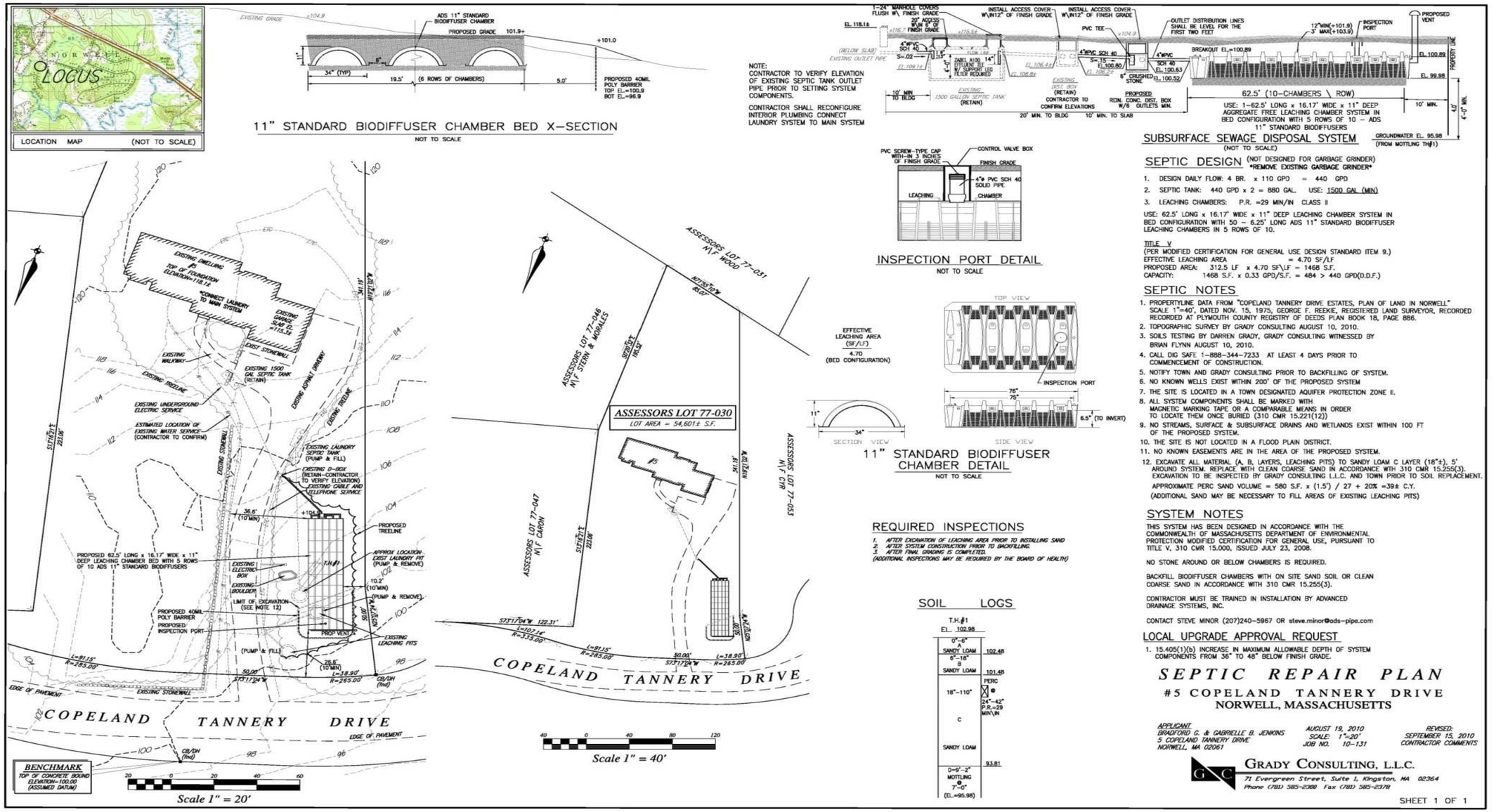
Typical Residential Septic System Upgrade Design

Soils Testing

- Permeability (perc rate)
- Groundwater determination

Survey

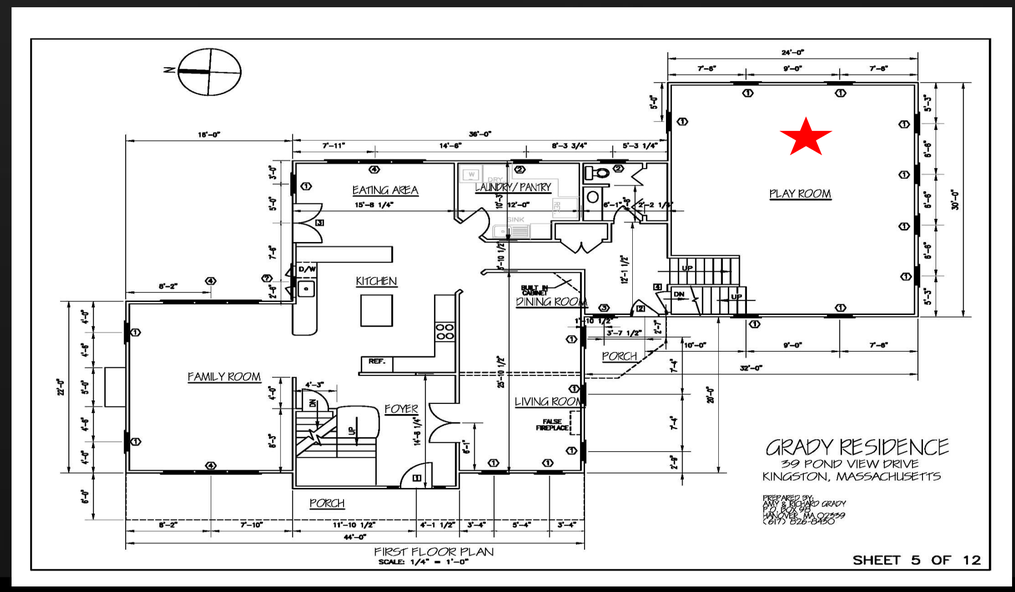
Typical Septic Plan



GRADY CONSULTING, L.L.C.

1998

- Rick & Kevin
- AutoCad R14 with Eagle Point
- Total Station & Data Collector
- Set up office in “Playroom” ★
- Primary focus on septic system design



Grady Consulting, L.L.C.

1999

- Added 1st full time employee.
- Various coop student engineers.
- Started diversifying services, larger projects with septic system design still primary focus.

2002

- Darren joined company.
- Steady business growth continued.

Grady Consulting, L.L.C.

2004

- Wife wanted to move and agreed to keep office over garage with pretty good view…

Grady Consulting, L.L.C.

2004

- Enabled purchase of property in Kingston center.

GRADY CONSULTING, L.L.C.

2006

- Added second full time employee

(bad timing…laid off end of year)

- Hmmm…something is different…
- *Things seem to be slowing a bit*.

2008

- Let's build an office while things are slow this winter.
- Opened September, 2008 - Added full time employee.

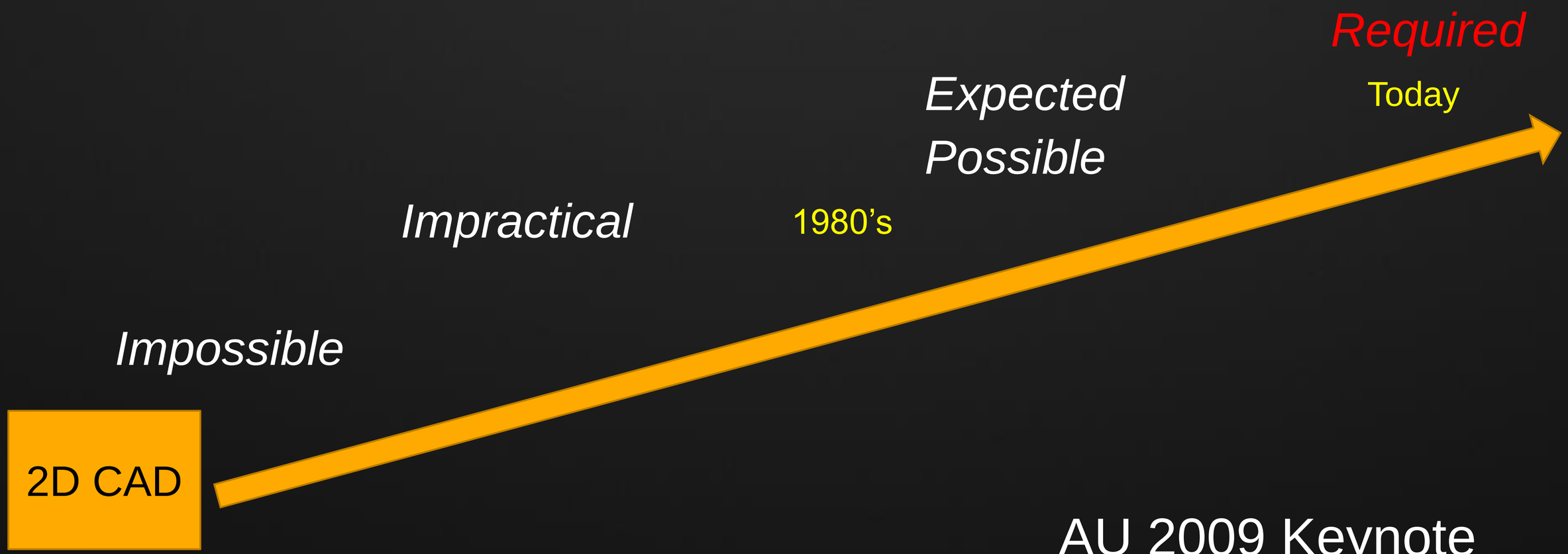
Grady Consulting, L.L.C.

2009

- Ok…maybe we misjudged the bottom.
- Are we really pricing our septic upgrades at 2000 prices, losing more on price and running over budget, too?
- Primary focus on septic system design.
- Stop watching the news - Let's examine processes, equipment, software, company structure. (Can we do anything differently?)
- Autodesk University 2009.

(Rick, Kevin, Darren)

Five Phases of Technology



AU 2009 Keynote

Grady Consulting, L.L.C.

2010 - Jumping in the Deep End

- Installed Autocad Civil 3d 2009.
- Upgraded workstations.
- Wrestling with decisions…

Would Scanner …

…improve efficiency?

…help us diversify?

…present new opportunities?

- Purchase Leica C-10.
- *(What do you mean it's sitting in Europe because of the volcanoes?)*
- Hired another full time employee in fall.

Typical Septic Upgrade Plans

Old Workflow = 24 Man Hours

Field Survey → Soil Testing → Office Design/Draft

(2 man crew x 4 hours)

8 Man Hours

6 Man Hours

10 Man Hours

Typical Septic Upgrade Plans

Old Workflow = 24 Man Hours

Field Survey → Soil Testing → Office Design/Draft

(2 man crew x 4 hours)

8 Man Hours 6 Man Hours 10 Man Hours

New Workflow = 21 Man Hours

Field Survey → Soil Testing → Office Design/Draft

(Scanner)

3 Man Hours 6 Man Hours 12 Man Hours

Field Methodology

- Scan density → medium, with images (7-8 minutes/scan)
- Registration method = Targets (auto-add constraints)
  Seldom use common points registration
- Project accuracy: depends on proximity to required setbacks

Office Methodology

Cyclone

- Create alignment (usually centerline street)
- Create sections (select start, end & spacing)
- Section manager (open each section along alignment)
- Virtual surveyor → pick points along section for random elevation points
- Export PNEZD file
- Separate point group for traverse (target locations)

CloudWorx in AutoCAD Civil 3D

- Import PNEZD file as existing surface
- Align point cloud with horizontal and vertical control
- Digitize linework using CloudWorx
- Return to Cyclone for items needing more accurate location (building corners, fences, utility poles, trees) / better visibility
- Draft 2d siteplan

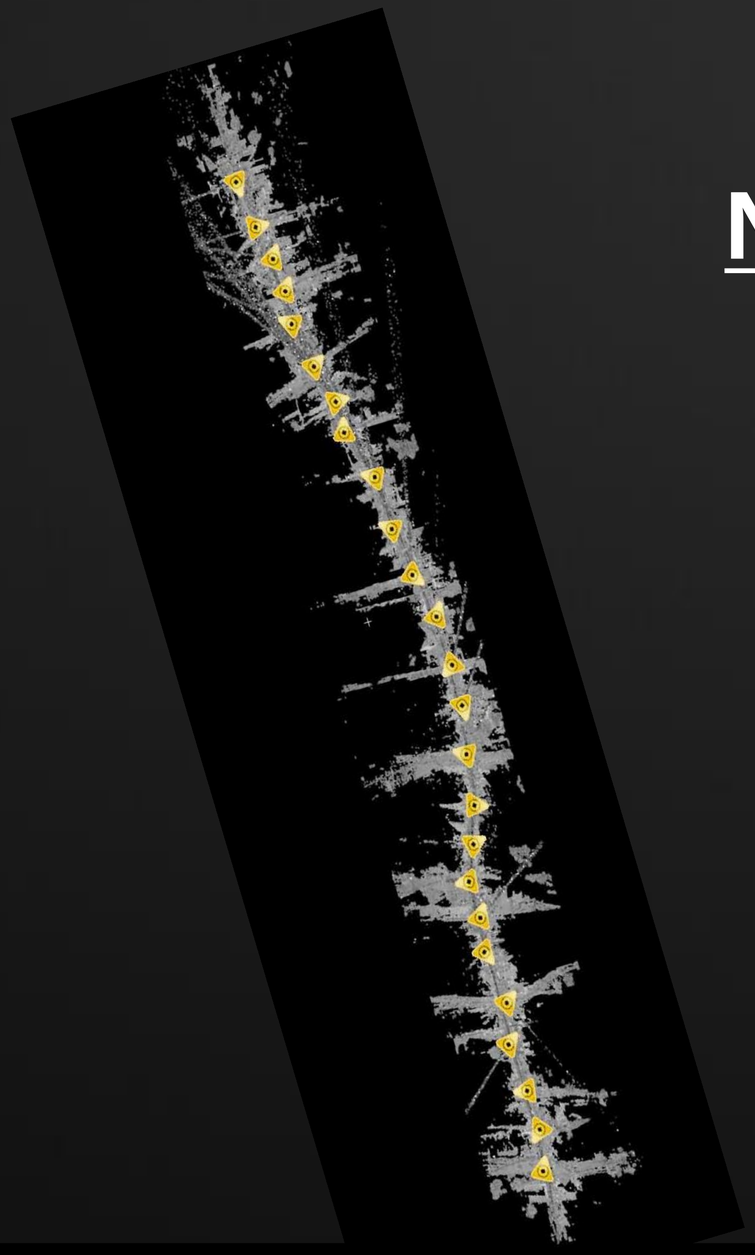
Scanner Benefits For Septic Jobs

- 3+ hours x 100 jobs/year = 300+ hours saved
- Frees up 2nd crew member for other work
- More efficient to allow double booking on one day
- Able to take on jobs at greater distances without return trips

Plus … New Opportunities

I need to prefabricate railings (in MA) for a cast in place variable width twin spiral staircase in Naples, FL…
can you scan it for me?

Sure!

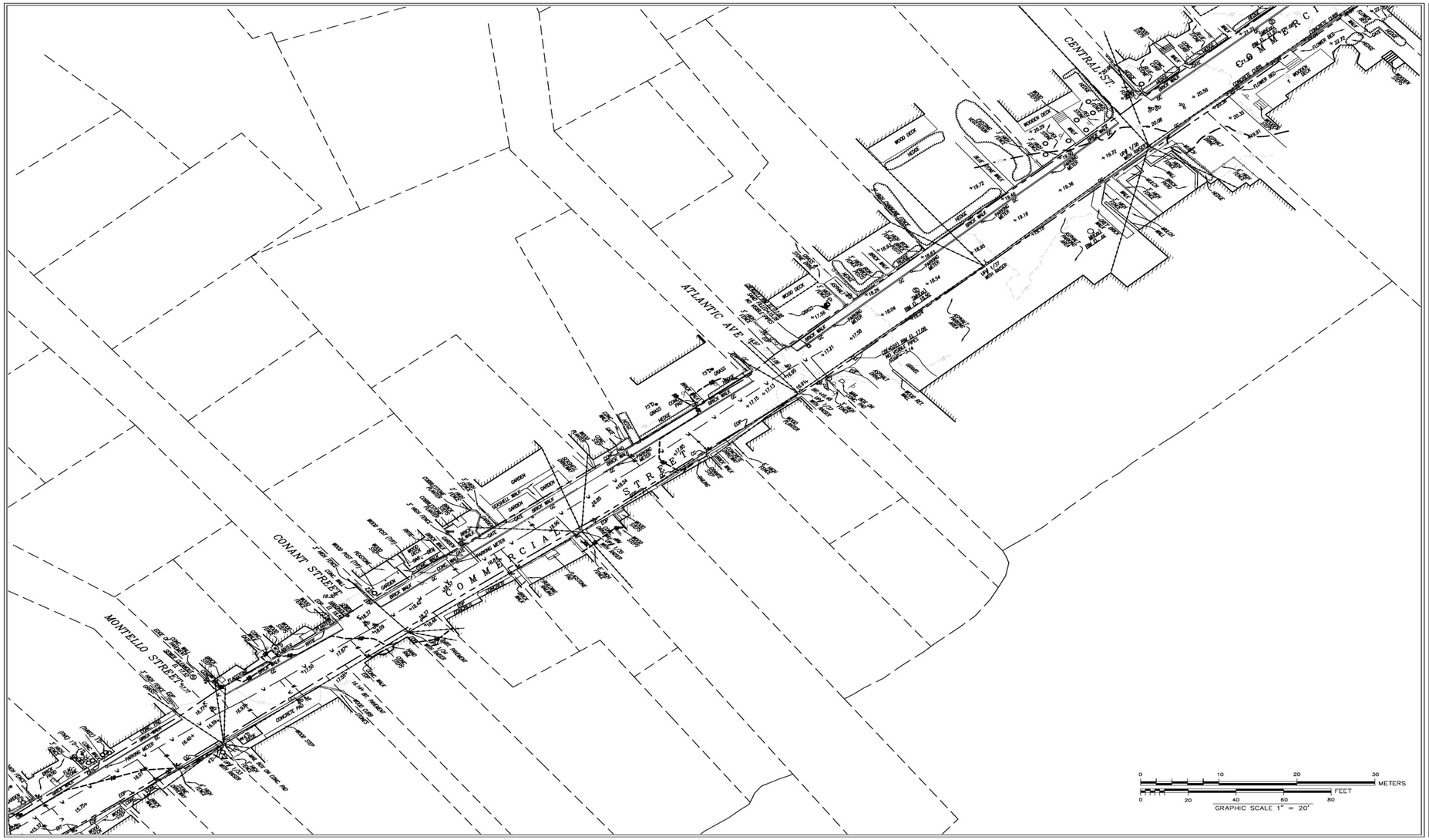


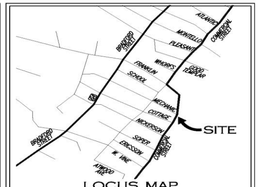
New Opportunities

"I need to do an existing conditions survey on Commercial Street in Provincetown…it's going to take my crew forever with the detail. So I looked into renting a scanner and it was suggested maybe I should partner with Grady."

(thanks Leica & MTS)

Finished Product – 2D Existing Conditions Plan





LOCUS MAP
NOT TO SCALE

NOTES

1. DATE OF SURVEY: 12-28-2009
2. PROPERTY LINES AND ROAD LINES ARE FROM THE TOWN GIS.

LEGEND

THIS MAPPING IS MADE FOR THE PARTY NAMED HEREON, HIS OR HER MORTGAGEE AND GUARANTOR, EXCLUSIVELY. NO FURTHER LIABILITY IS ASSUMED.

REVISIONS

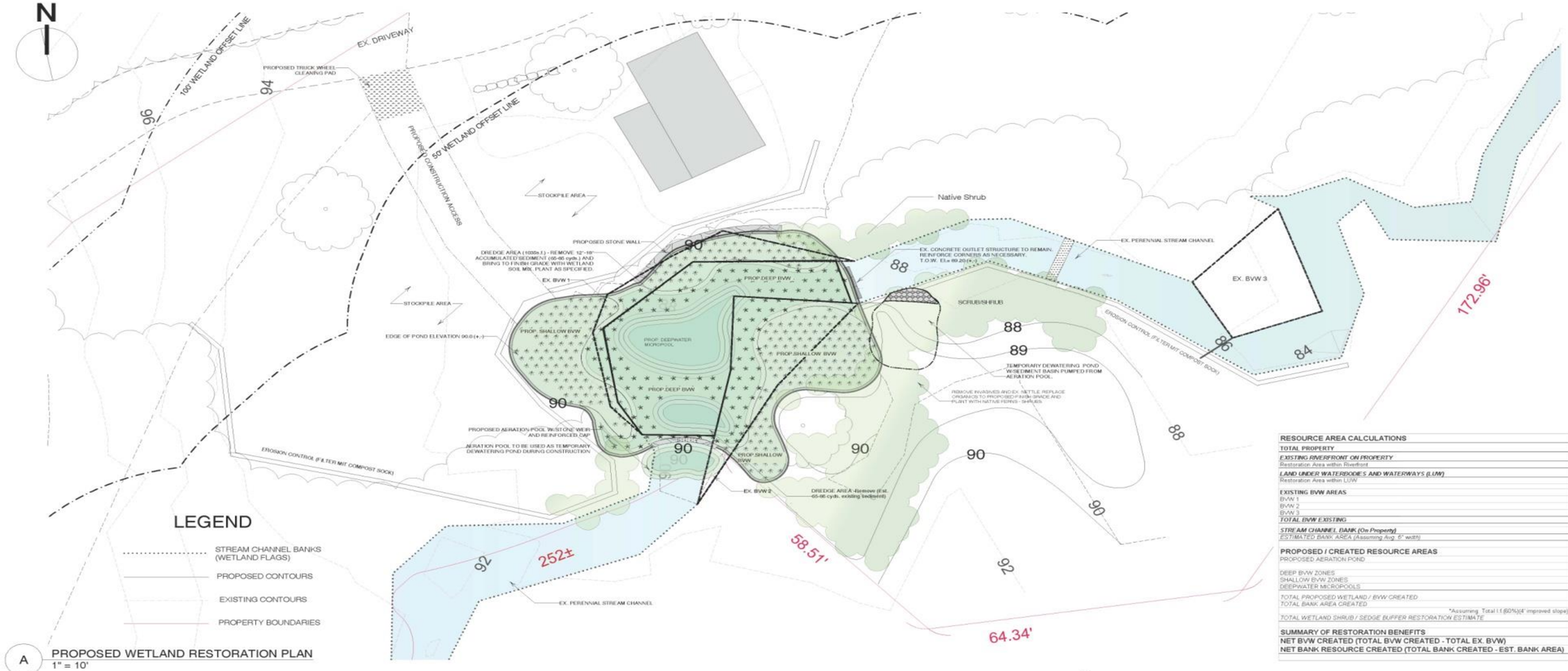
DATE	DESCRIPTION	INIT.

EXISTING CONDITIONS
AT
COMMERCIAL STREET
IN
PROVINCETOWN,
MASSACHUSETTS
PREPARED FOR
STEARNS & WHELER

BENNETT ENGINEERING
LAND SURVEYING, ENGINEERING, & DEVELOPMENT SERVICES
PO BOX 297
SAGAMORE BEACH, MA 02562
TEL. (508) 888-4868
FAX. (508) 888-4867

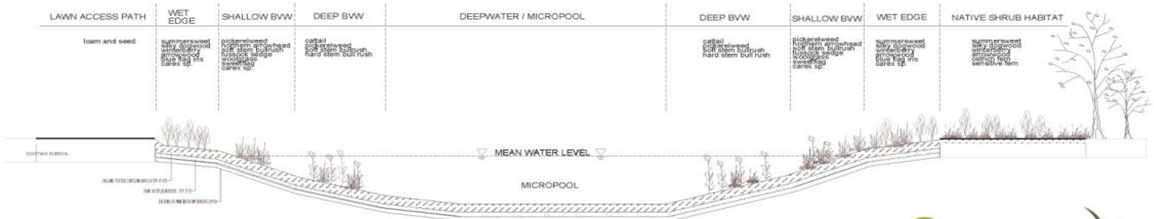
DRAWN BY: JDP
CHECK BY: TRB
JOB # 1358
DATE: 03/19/2010
SCALE: 1"=20'
SHEET NO. 4 OF 4

Stream Restoration Project



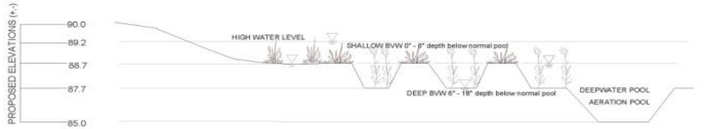
A PROPOSED WETLAND RESTORATION PLAN
1" = 10'

RESOURCE AREA CALCULATIONS	AREA (s.f.)	ACRES
TOTAL PROPERTY	136898.00	3.17
EXISTING RIVERFRONT ON PROPERTY	122941.00	2.90
Restoration Area within Riverfront	3992	
LAND UNDER WATERBODIES AND WATERWAYS (LUW)	2872.00	
Restoration Area within LUW	2872	
EXISTING BVW AREAS		
BVW 1	270	
BVW 2	433	
BVW 3	505	
TOTAL BVW EXISTING	1208	
STREAM CHANNEL BANK (On Property)	1067 l.f.	
ESTIMATED BANK AREA (Assuming Avg. 5' width)	533.5	
PROPOSED / CREATED RESOURCE AREAS		
PROPOSED AERATION POND	115	
DEEP BVW ZONES	1424	
SHALLOW BVW ZONES	826	
DEEPWATER MICROPOOLS	607	
TOTAL PROPOSED WETLAND / BVW CREATED	2872	
TOTAL BANK AREA CREATED	2561	
*Assuming Total I:1 (50%)(4' improved slope)		
TOTAL WETLAND SHRUB / SEDGE BUFFER RESTORATION ESTIMATE	3500	
SUMMARY OF RESTORATION BENEFITS		
NET BVW CREATED (TOTAL BVW CREATED - TOTAL EX. BVW)	1664	
NET BANK RESOURCE CREATED (TOTAL BANK CREATED - EST. BANK AREA)	2027	



B CONCEPTUAL WETLAND SECTION
N.T.S.

EXCAVATE CONSTRUCTED WETLAND AREA TO BASE LAYER AND BUILD TO PROPOSED ELEVATIONS WITH SAND / WETLAND SOIL MIX. BOTTOM COMPOSITION SHALL BE INSPECTED BY SITE DESIGNER PRIOR TO BUILDING TOPOGRAPHY IN ORDER TO DETERMINE LOCATION OF IMPERVIOUS LINERS.



C CONCEPTUAL WETLAND ELEVATION PROFILE
N.T.S.

HOWARD • GARDEN DESIGNS
94 FAIRFAX STREET / WEST NEWTON, MA
PH: 617-244-7200 / www.howardgardendesigns.com

ECO TERRA Design & Consulting
26 HILL STREET / MEDWAY, MA 02053
PH: 508-429-6334 / www.ecoterradesign.com

McCARTHY RESIDENCE - 88 COTTAGE STREET - BROOKLINE, MA
DATE: 01-07-2011
L1 - PROPOSED WETLAND/HABITAT RESTORATION CONCEPT PLAN
SCALE: AS NOTED
REVISIONS: 1-07-2011, DEP Comments, Limits of Work

MA GIS ORTHOIMAGE OF SITE
NO SCALE

SARGENT POND

DENOTES AREAS WHERE BANK UNDERCUTTING IS MOST SEVERE

EX. WOODEN FOOT BRIDGE


33' Width x 3' Depth
Heavily Cut Banks


46' Width x 6.75' Depth
Heavy Invasive Vegetation Cover


Cut Banks and Invasive Vegetation


55' Width x 1' Depth
View From Wooden Bridge


Heavily Cut Bank on Far Side

STREAM MONITORING STATION 5

STREAM MONITORING STATION 4

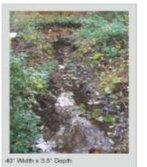

60' Width x 3.25' Depth


72' Width x 2' Depth


52' Width x 4.5' Depth


Existing Concrete Headwall Structure

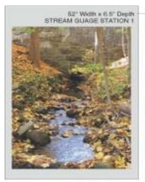

Cut banks and Invasive Vegetation


40' Width x 3.5' Depth


50' Width x 3' Depth
Rocky Bottom


43' Width x 8' Depth
Heavily Cut Banks

STREAM MONITORING STATION 1


52' Width x 6.5' Depth
STREAM GUAGE STATION 1


86' Width x <1' Depth
Braided Channel Section


Braided Channel w/vegetation
Heavily Cut Bank


34' Width x 5.75' Depth
Grassy Channel


35' Width x 4.75' Depth
Heavily Cut Banks

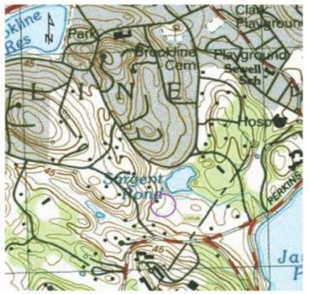

Cut Banks along neighbors lawn area

STREAM MONITORING STATION 2

COTTAGE STREET

N

USGS TOPOGRAPHIC VIEW OF LOCUS
NO SCALE



NOTES:
Arrows point to respective location at wetland flag or surface feature where photo was taken.

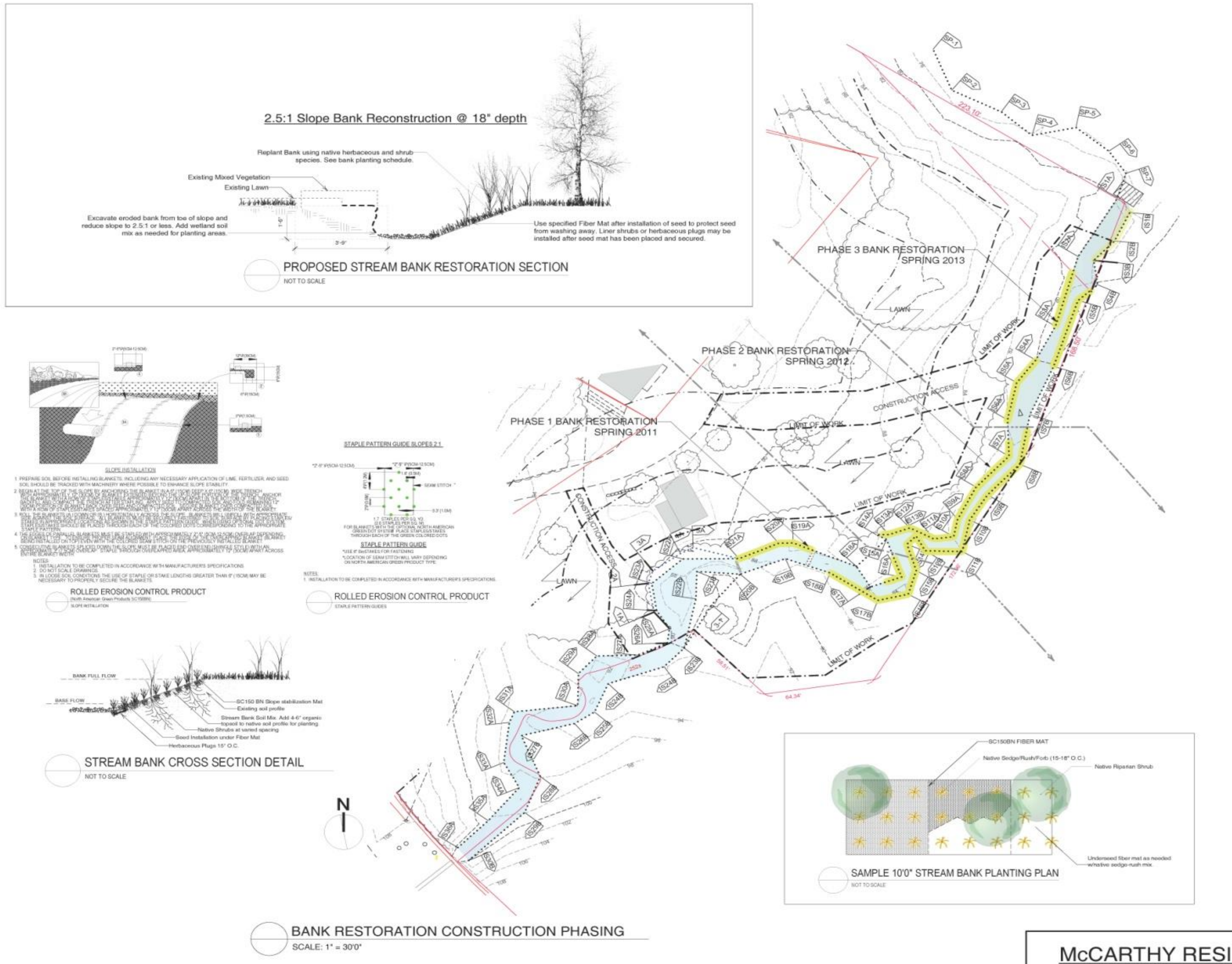
Dimensions shown in photo captions represent stream width and centerline depth on 10-28-2010.

All photos taken 10-28-2010 and show view looking upstream toward Cottage Street unless otherwise noted.

HOWARD • GARDEN DESIGNS
34 FAIRFAX STREET / WEST NEWTON, MA
PH: 617-244-7089 / www.howardgardendesigns.com

ECO TERRA DESIGN & CONSULTING
26 HILL STREET / MEDWAY, MA 02053
PH: 508-429-6334 / www.ecoterradesign.com

McCARTHY RESIDENCE - 88 COTTAGE STREET - BROOKLINE, MA
DATE: 11-19-2010
L2 - STREAM REACH EXISTING CONDITIONS MAP
SCALE: 1" = 30'0"



CONSTRUCTED WETLAND PLANTING SCHEDULE				
COMMON NAME	BOTANICAL NAME	SIZE	SPACING	WETLAND STATUS
WET EDGE SHRUB SPECIES				
Swamp Azalea	*Rhododendron viscosum*	18-24"	16' O.C.	OBL
Silky Dogwood	*Cornus amomum*	18-24"	16' O.C.	FACW
Red-osier Dogwood	*Cornus sericea*	18-24"	16' O.C.	FACW+
Winterberry	*Ilex verticillata*	18-24"	16' O.C.	FACW+
Sweet Pepperbush	*Clethra alnifolia*	18-24"	16' O.C.	FAC+
Inkberry	*Ilex glabra*	18-24"	16' O.C.	FACW-
Arrowwood	*Viburnum dentatum*	18-24"	16' O.C.	FACW-
American Cranberry	*Viburnum trilobum*	18-24"	16' O.C.	FACW
WET EDGE HERBACEOUS SPECIES				
Ostrich Fern	*Matteuccia struthiopteris*	2" plug	18"-24" O.C.	FACW
Royal Fern	*Osmunda regalis*	2" plug	18"-24" O.C.	OBL
Swamp Milkweed	*Asclepias incarnata*	2" plug	18"-24" O.C.	OBL
Fringed sedge	*Carex crinita*	2" plug	18"-24" O.C.	OBL
Hop sedge	*Carex lupulina*	2" plug / Seed	18"-24" O.C.	OBL
Tussock Sedge	*Carex stricta*	2" plug / Seed	18"-24" O.C.	OBL
Fox Sedge	*Carex vulpinoidea*	2" plug / Seed	18"-24" O.C.	OBL
Soft rush	*Juncus effusus*	2" plug / Seed	18"-24" O.C.	OBL
Joe-Pye Weed	*Eupatorium maculatum*	2" plug	18"-24" O.C.	FACW / FAC
Blue Flag Iris	*Iris versicolor*	2" plug	18"-24" O.C.	OBL
Turtlehead	*Chelone glabra*	2" plug	18"-24" O.C.	OBL
SHALLOW BVW ZONE				
Pickerelweed	*Pontederia cordata*	2" plug	18"-24" O.C.	OBL
Northern Arrowhead	*Sagittaria latifolia*	2" plug	18"-24" O.C.	OBL
Soft Stem Bullrush	*Schoenoplectus tabernaemontani*	2" plug	18"-24" O.C.	OBL
Tussock Sedge	*Carex stricta*	2" plug	18"-24" O.C.	OBL
Sweetflag	*Acorus americanus*	2" plug	18"-24" O.C.	OBL
Carex spp.	*Carex spp.*	2" plug	18"-24" O.C.	OBL
DEEP BVW ZONE				
Cattail	*Typha latifolia*	2" plug	18"-24" O.C.	OBL
Pickerelweed	*Pontederia cordata*	2" plug	18"-24" O.C.	OBL
Hard Stem Bullrush	*Schoenoplectus americanus*	2" plug	18"-24" O.C.	OBL
Soft Stem Bullrush	*Schoenoplectus tabernaemontani*	2" plug	18"-24" O.C.	OBL

SCRUB SHRUB WETLAND PLANTING SCHEDULE				
COMMON NAME	BOTANICAL NAME	SIZE	SPACING	WETLAND STATUS
SHRUB SPECIES				
Swamp Azalea	*Rhododendron viscosum*	18-24"	16' O.C.	OBL
Winterberry	*Ilex verticillata*	18-24"	16' O.C.	FACW+
Sweet Pepperbush	*Clethra alnifolia*	18-24"	16' O.C.	FAC+
Highbush Blueberry	*Vaccinium corymbosum*	18-24"	16' O.C.	FACW
Arrowwood	*Viburnum dentatum*	18-24"	16' O.C.	FACW-
American Cranberry	*Viburnum trilobum*	18-24"	16' O.C.	FACW
HERBACEOUS SPECIES				
Ostrich Fern	*Matteuccia struthiopteris*	2" plug	18"-24" O.C.	FACW
Royal Fern	*Osmunda regalis*	2" plug	18"-24" O.C.	OBL
Fox Sedge	*Carex vulpinoidea*	2" plug / Seed	18"-24" O.C.	OBL
Soft rush	*Juncus effusus*	2" plug / Seed	18"-24" O.C.	OBL
Short-toothed Mountain Mint	*Pycnanthemum muticum*	2" plug	18"-24" O.C.	FACW

STREAM BANK RESTORATION PLANTING SCHEDULE				
COMMON NAME	BOTANICAL NAME	SIZE	SPACING	WETLAND STATUS
SHRUB SPECIES				
Swamp Azalea	*Rhododendron viscosum*	18-24"	16' O.C.	OBL
Silky Dogwood	*Cornus amomum*	18-24"	16' O.C.	FACW
Red-osier Dogwood	*Cornus sericea*	18-24"	16' O.C.	FACW+
Winterberry	*Ilex verticillata*	18-24"	16' O.C.	FACW+
Sweet Pepperbush	*Clethra alnifolia*	18-24"	16' O.C.	FAC+
HERBACEOUS SPECIES				
Canada rush	*Juncus canadensis*	2" plug / Seed	15" O.C.	OBL
Soft rush	*Juncus effusus*	2" plug / Seed	15" O.C.	OBL
Fox Sedge	*Carex vulpinoidea*	2" plug / Seed	15" O.C.	OBL
Squarrose Sedge	*Carex squarrosa*	2" plug / Seed	15" O.C.	FACW
Many Leaved Bulrush	*Scirpus polyphyllus*	2" plug / Seed	15" O.C.	OBL
Green Bulrush	*Scirpus atrovirens*	2" plug / Seed	15" O.C.	OBL
Wool grass	*Scirpus cyperinus*	2" plug / Seed	15" O.C.	FACW+
Fringed sedge	*Carex crinita*	2" plug / Seed	15" O.C.	OBL
Hop sedge	*Carex lupulina*	2" plug / Seed	15" O.C.	OBL
Blue Flag Iris	*Iris versicolor*	2" plug	15" O.C.	OBL
Ostrich Fern	*Matteuccia struthiopteris*	2" plug	15" O.C.	FACW
Swamp Milkweed	*Asclepias incarnata*	2" plug	15" O.C.	OBL
Joe-Pye Weed	*Eupatorium maculatum*	2" plug	15" O.C.	FACW / FAC
Cardinal Flower	*Lobelia cardinalis*	2" plug	15" O.C.	FACW+
Turtlehead	*Chelone glabra*	2" plug	15" O.C.	OBL

PLANTING SCHEDULES

HOWARD • GARDEN DESIGNS
34 FAIRFAX STREET / WEST NEWTON, MA

ECO TERRA Design & Consulting
26 HILL STREET / MEDWAY, MA 02053
PH: 508-429-6334 / www.ecoterradesign.com

McCARTHY RESIDENCE - 88 COTTAGE STREET - BROOKLINE, MA
DATE: 01-07-2011
L3 - STREAM BANK STABILIZATION PLAN / DETAILS
SCALE: AS NOTED
REVISIONS: 1-07-2011, DEP Comments, Limits of Work

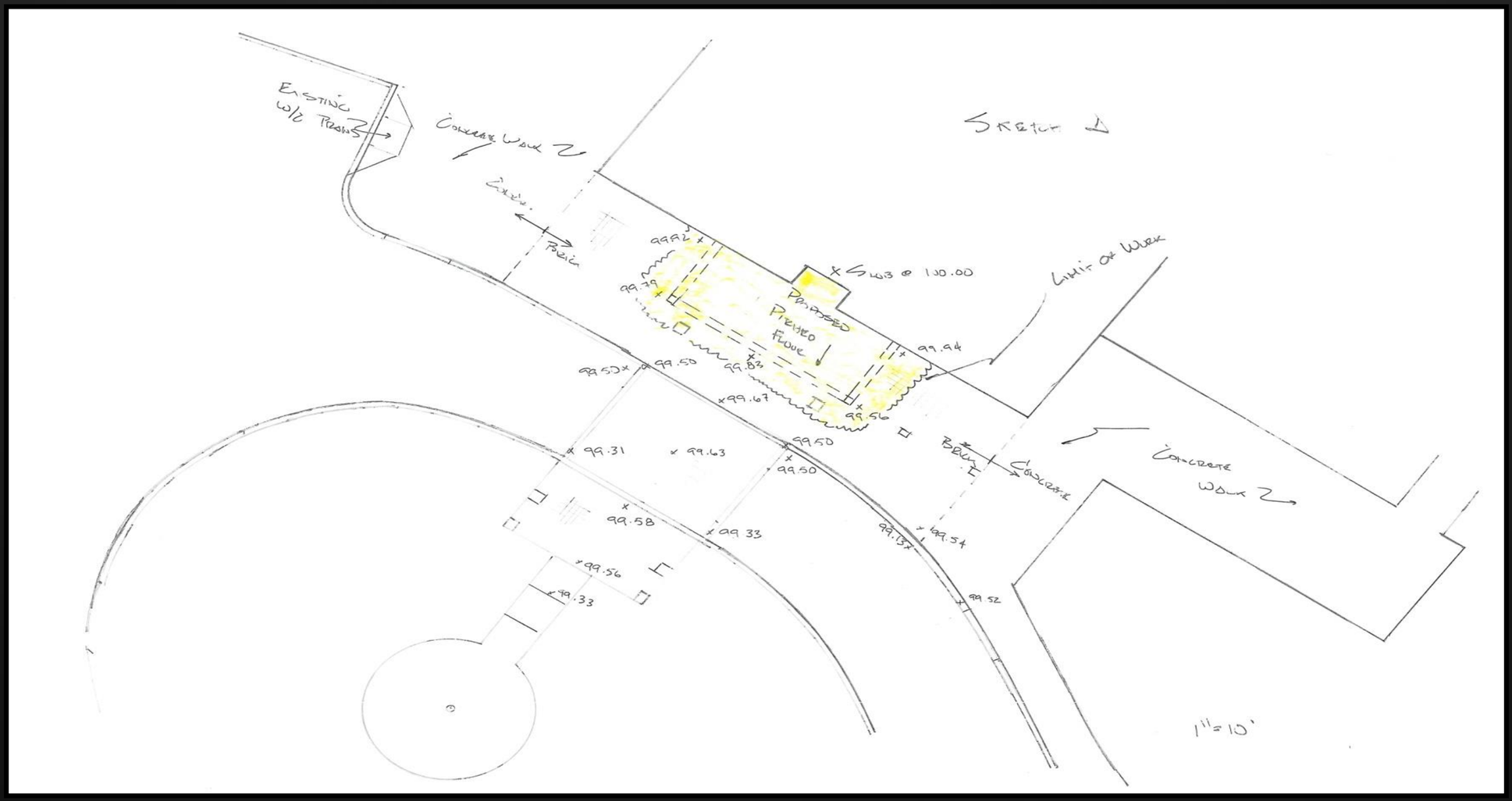
Autodesk University

GRADY CONSULTING, L.L.C.

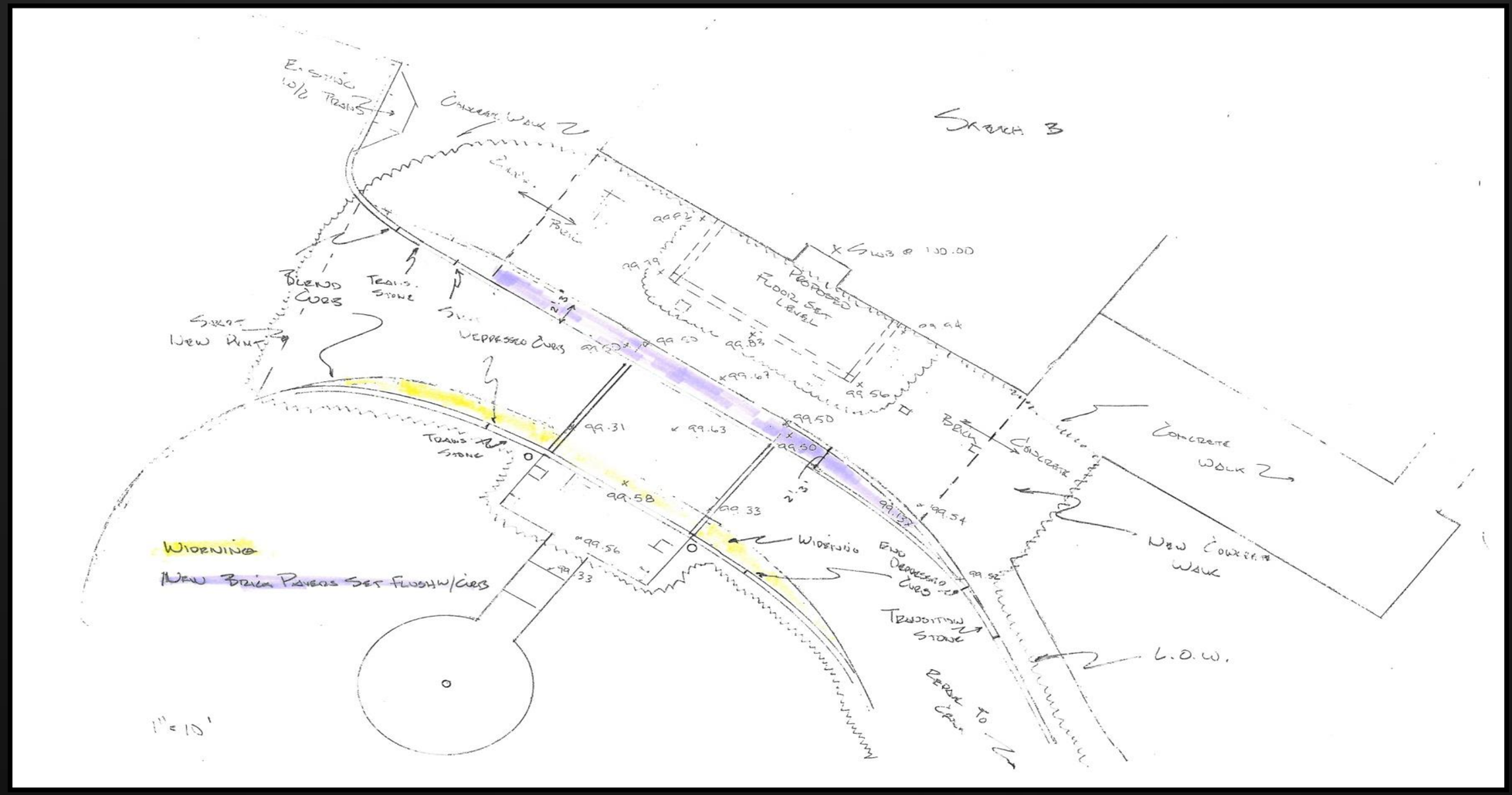
The Village at Duxbury, Senior Living Facility

- 3D laser scanning of existing entry
- Detailed grading plans for driveway drop -off at existing portico, with curbing and handicap accessible walkways

Contractor Sketch - The Village at Duxbury



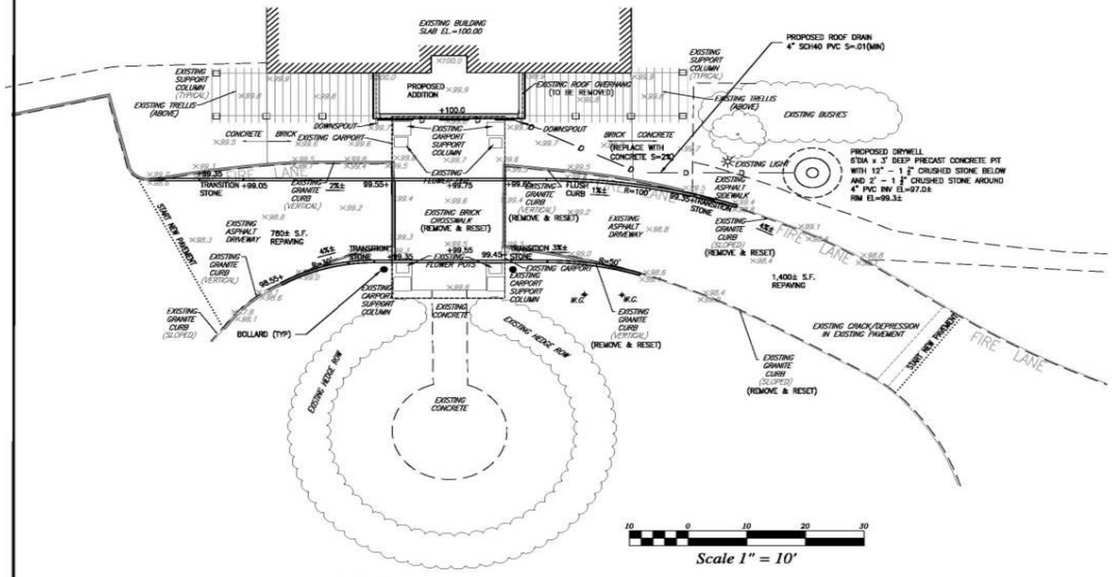
Contractor Sketch - The Village at Duxbury



LASER SCANNER PHOTOGRAPH
(SCANNING STATION #1)

LASER SCANNER PHOTOGRAPH
(SCANNING STATION #2)

LASER SCANNER PHOTOGRAPH
(SCANNING STATION #3)



PLAN VIEW

LASER SCANNER POINT CLOUD IMAGE

SITE PLAN

VILLAGE AT DUXBURY
290 KINGS TOWN WAY
DUXBURY, MASSACHUSETTS

APPLICANT
SEALUND CORPORTION
794 WASHINGTON STREET
PEMBROKE, MA 02359

MAY 4, 2012
SCALE: 1" = 5'
JOB NO. 12-077

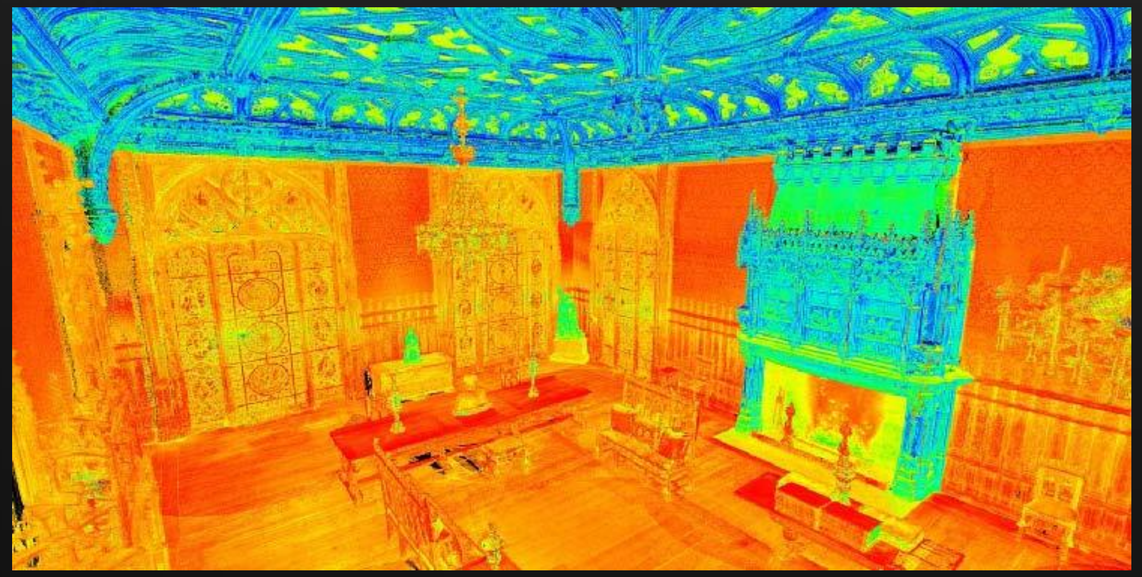
GRADY CONSULTING, L.L.C.
71 Evergreen Street, Suite 1, Kingston, MA 02364
Phone (781) 585-2300 Fax (781) 585-2378

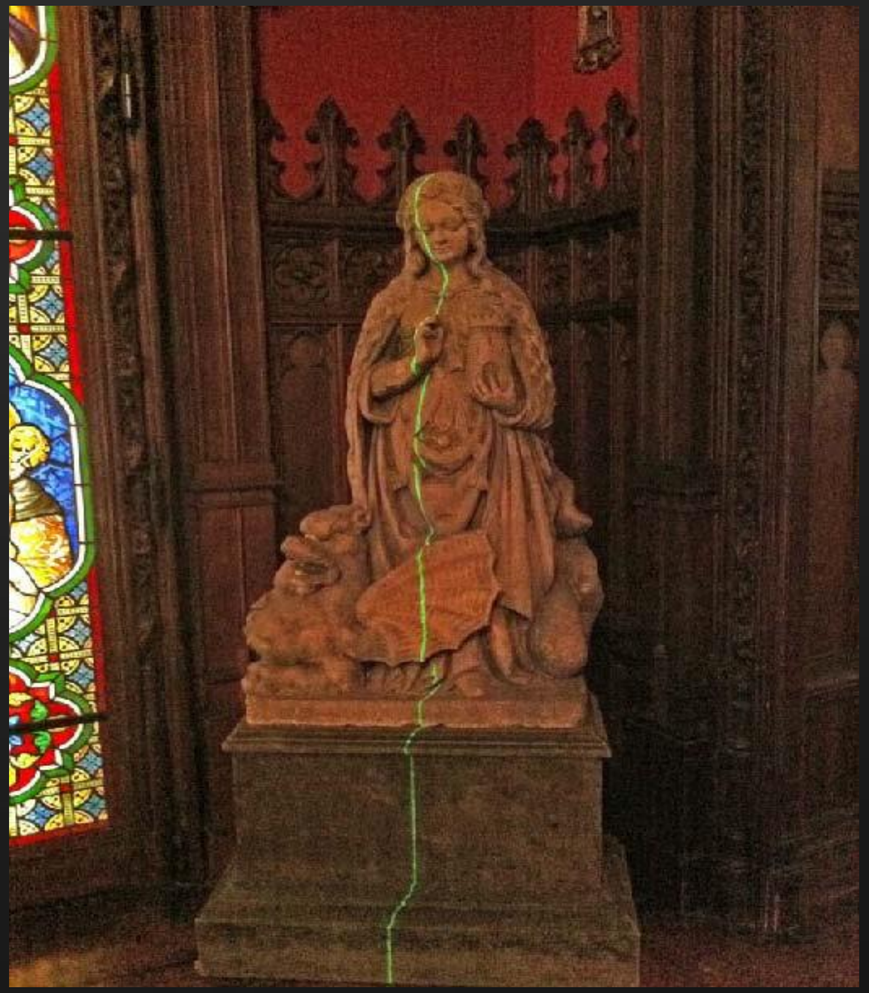
SHEET 1 OF 1

Marble House
Newport, RI

- Grady Consulting partnered with CyArk to digitally preserve a national
  - historic landmark.

Digital Repatriation: Marble House

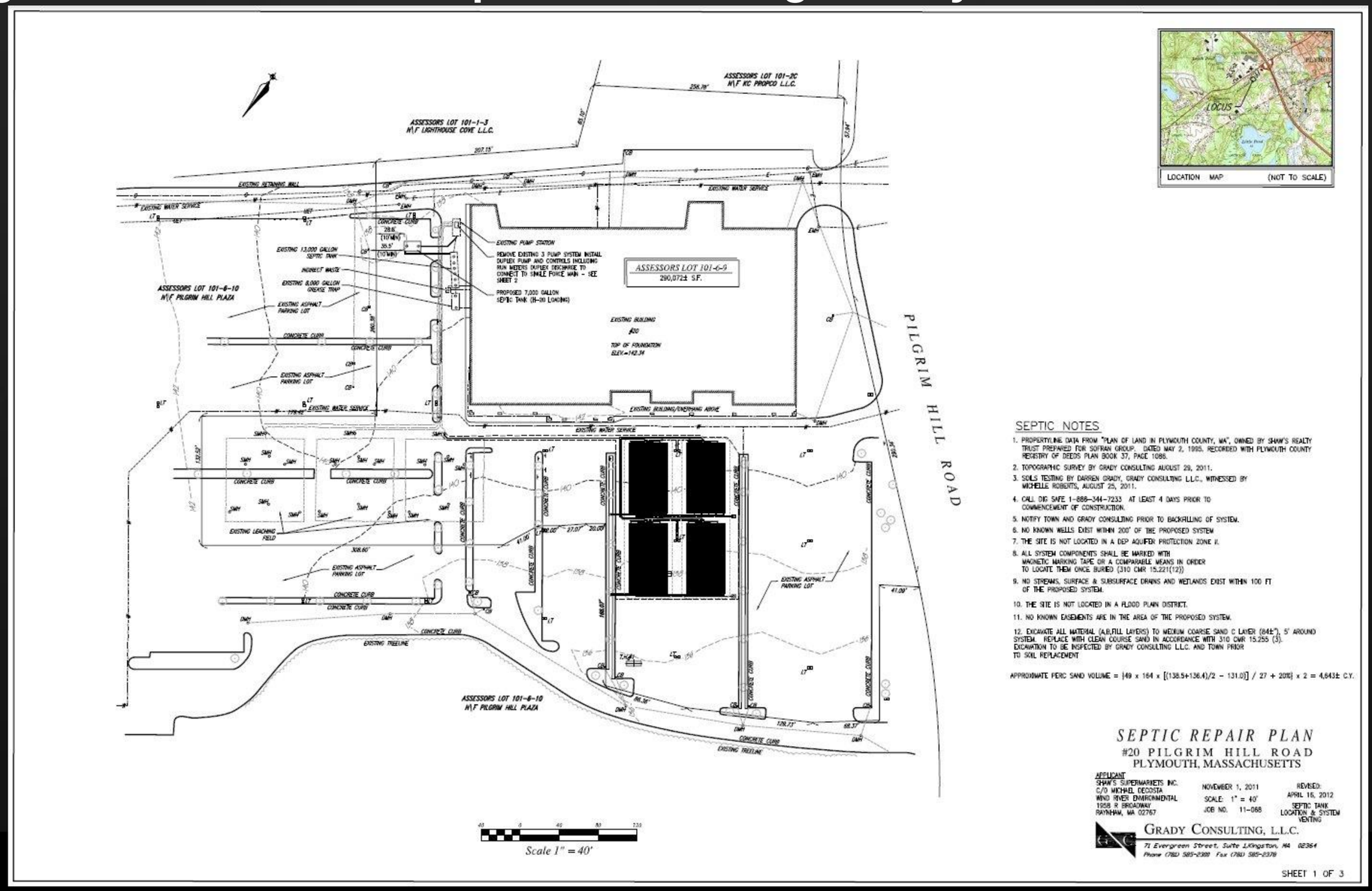




Commercial Job – Plymouth, MA

Proposed Septic Plan

Initial Design and Location of Proposed Leaching Facility



SEPTIC NOTES

1. PROPERTYLINE DATA FROM "PLAN OF LAND IN PLYMOUTH COUNTY, MA", OWNED BY SHAW'S REALTY TRUST PREPARED FOR SOFRAN GROUP. DATED MAY 2, 1995. RECORDED WITH PLYMOUTH COUNTY REGISTRY OF DEEDS PLAN BOOK 37, PAGE 1086.
2. TOPOGRAPHIC SURVEY BY GRADY CONSULTING AUGUST 29, 2011.
3. SOILS TESTING BY DARREN GRADY, GRADY CONSULTING L.L.C., WITNESSED BY MICHELLE ROBERTS, AUGUST 25, 2011.
4. CALL DIG SAFE 1-888-344-7233 AT LEAST 4 DAYS PRIOR TO COMMENCEMENT OF CONSTRUCTION.
5. NOTIFY TOWN AND GRADY CONSULTING PRIOR TO BACKFILLING OF SYSTEM.
6. NO KNOWN WELLS EXIST WITHIN 200' OF THE PROPOSED SYSTEM
7. THE SITE IS NOT LOCATED IN A DEP AQUIFER PROTECTION ZONE II.
8. ALL SYSTEM COMPONENTS SHALL BE MARKED WITH MAGNETIC MARKING TAPE OR A COMPARABLE MEANS IN ORDER TO LOCATE THEM ONCE BURIED (310 CMR 15.221(12))
9. NO STREAMS, SURFACE & SUBSURFACE DRAINS AND WETLANDS EXIST WITHIN 100 FT OF THE PROPOSED SYSTEM.
10. THE SITE IS NOT LOCATED IN A FLOOD PLAIN DISTRICT.
11. NO KNOWN EASEMENTS ARE IN THE AREA OF THE PROPOSED SYSTEM.
12. EXCAVATE ALL MATERIAL (A,B,FILL LAYERS) TO MEDIUM COARSE SAND C LAYER (84±"), 5' AROUND SYSTEM. REPLACE WITH CLEAN COURSE SAND IN ACCORDANCE WITH 310 CMR 15.255 (3). EXCAVATION TO BE INSPECTED BY GRADY CONSULTING L.L.C. AND TOWN PRIOR TO SOIL REPLACEMENT

APPROXIMATE PERC SAND VOLUME = [49 x 164 x [(138.5+136.4)/2 − 131.0)] / 27 + 20%] x 2 = 4,643± C.Y.

SEPTIC REPAIR PLAN

#20 PILGRIM HILL ROAD
PLYMOUTH, MASSACHUSETTS

APPLICANT
SHAW'S SUPERMARKETS INC.
C/O MICHAEL DECOSTA
WIND RIVER ENVIRONMENTAL
1958 R BROADWAY
RAYNHAM, MA 02767

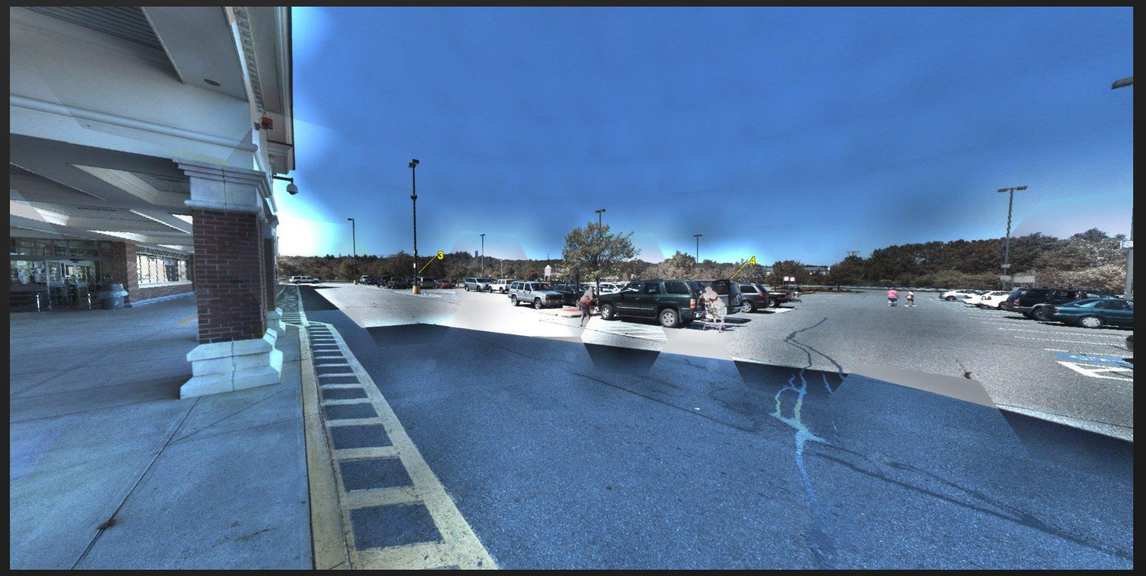
NOVEMBER 1, 2011
SCALE: 1" = 40'
JOB NO. 11-068

REVISED:
APRIL 16, 2012
SEPTIC TANK LOCATION & SYSTEM VENTING

GRADY CONSULTING, L.L.C.
71 Evergreen Street, Suite 1, Kingston, MA 02364
Phone (781) 585-2388 Fax (781) 585-2378

SHEET 1 OF 3

Pre-Excavation



Photos taken from the onboard camera of the Leica C10 Scanner during the existing conditions survey. The photos show the location of the proposed leaching facility prior to excavation.

Pre-Excavation

Existing conditions scans compiled of 4 different scan locations throughout the site.

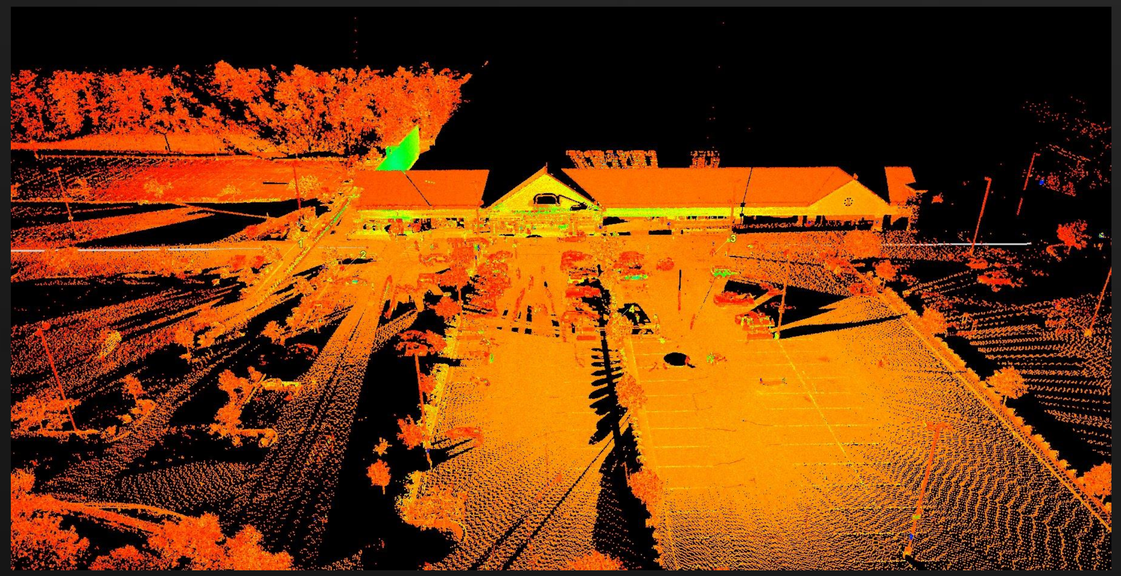


Image of point cloud before photos were applied.

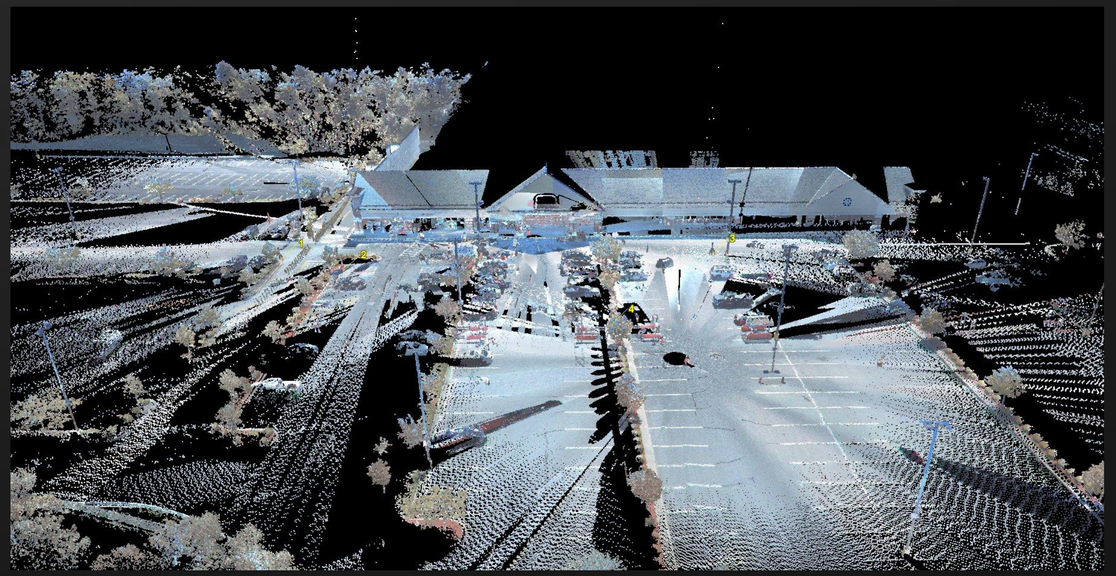
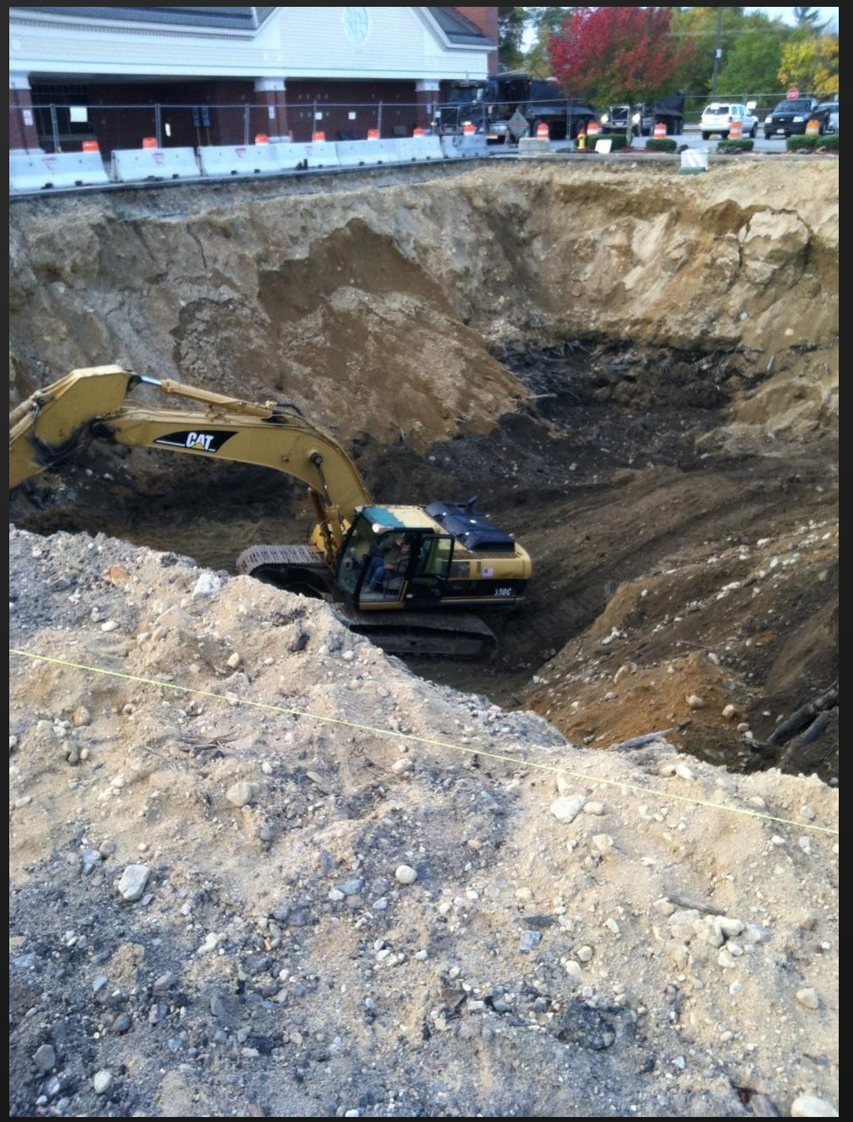


Image of point cloud after photos were applied.

Excavation



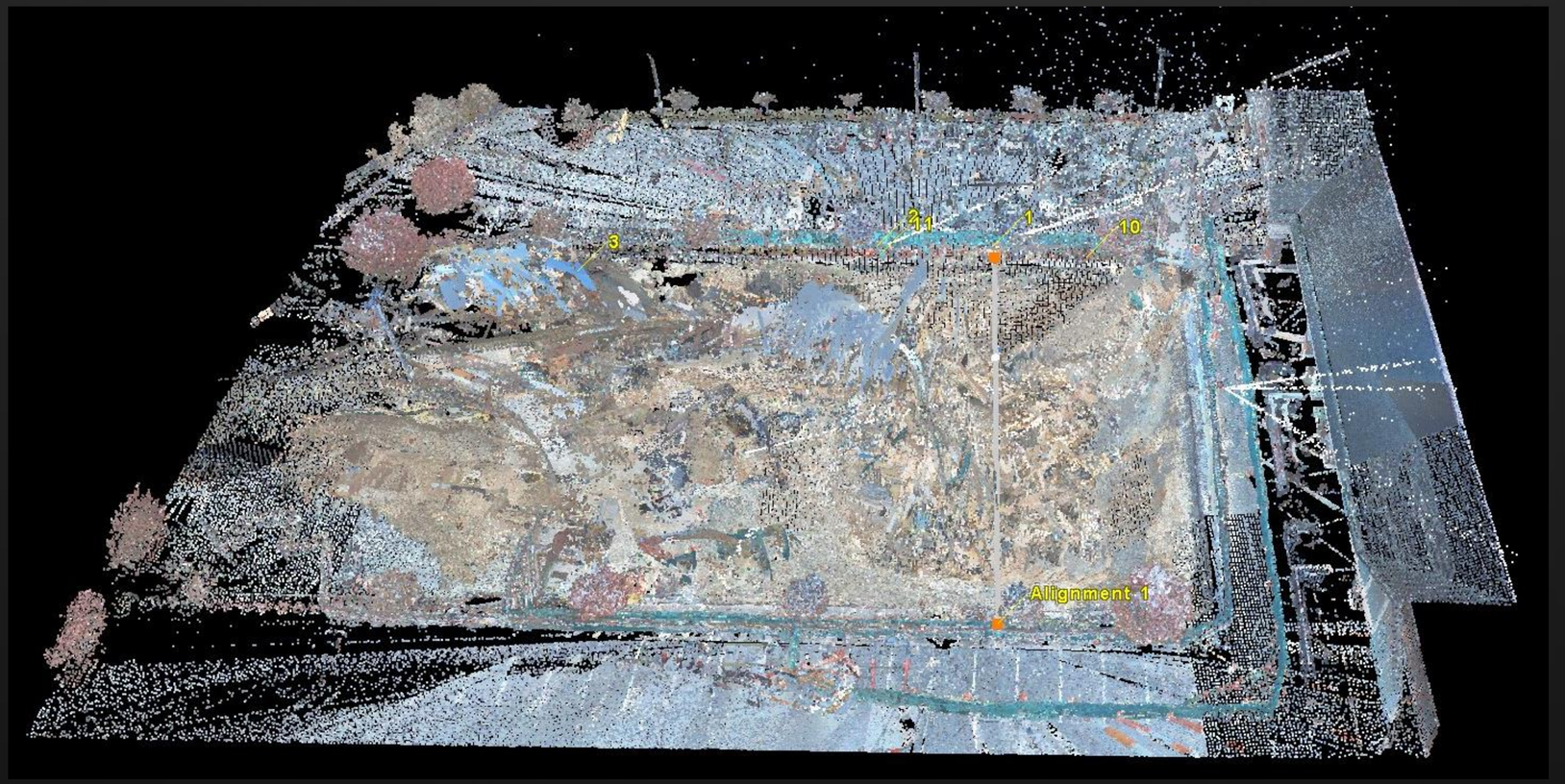
Excavation

Photograph.

Photo of Scan.

Processing Data Collected with the Leica C10 Scanner

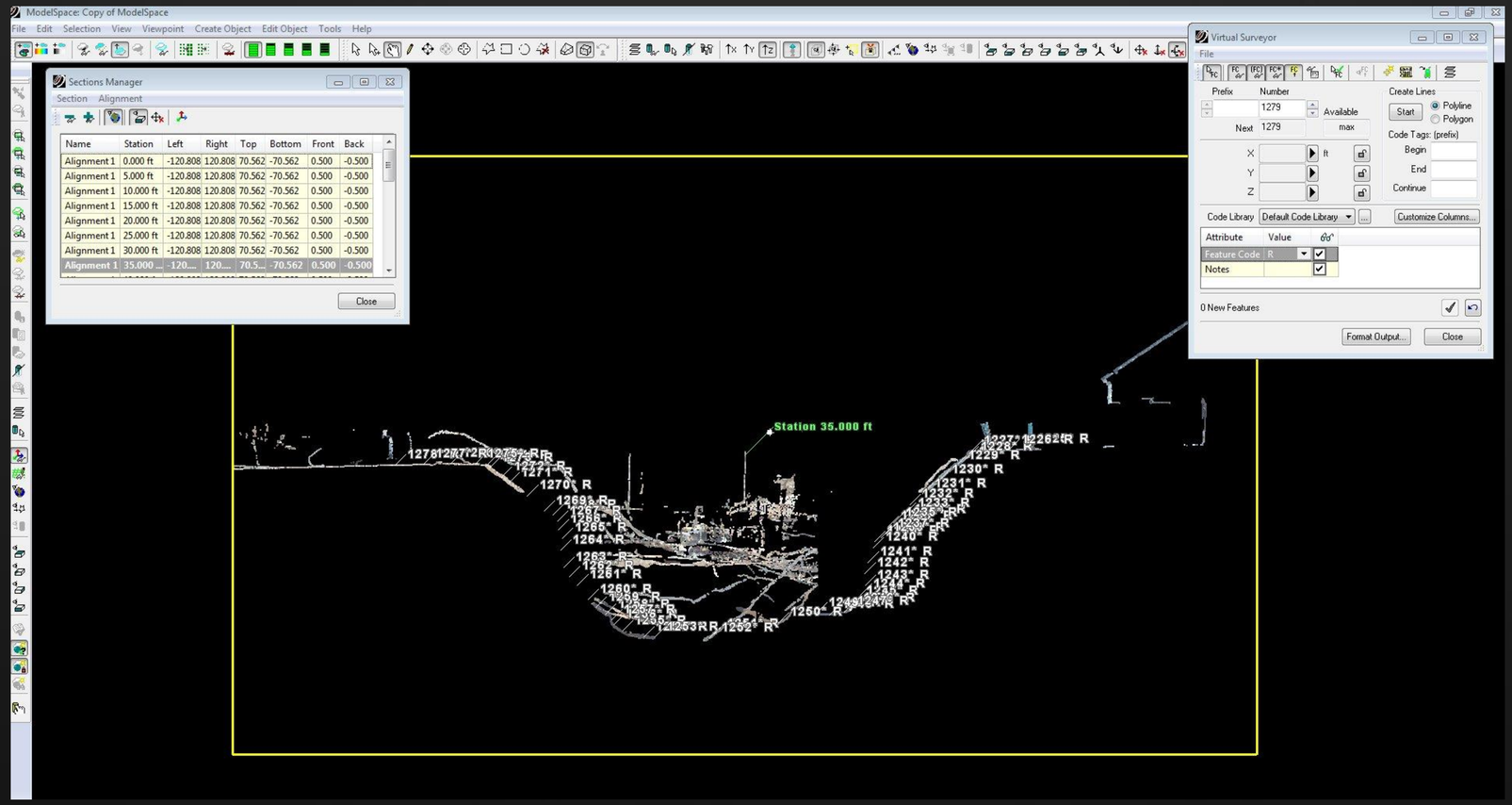
1. Alignment



Created an alignment running parallel with the existing building through the middle of the excavation.
The alignment was 130 feet long (approximately the length of the excavation).
X-sections were created every 5 feet.

Processing Data Collected with the Leica C10 Scanner

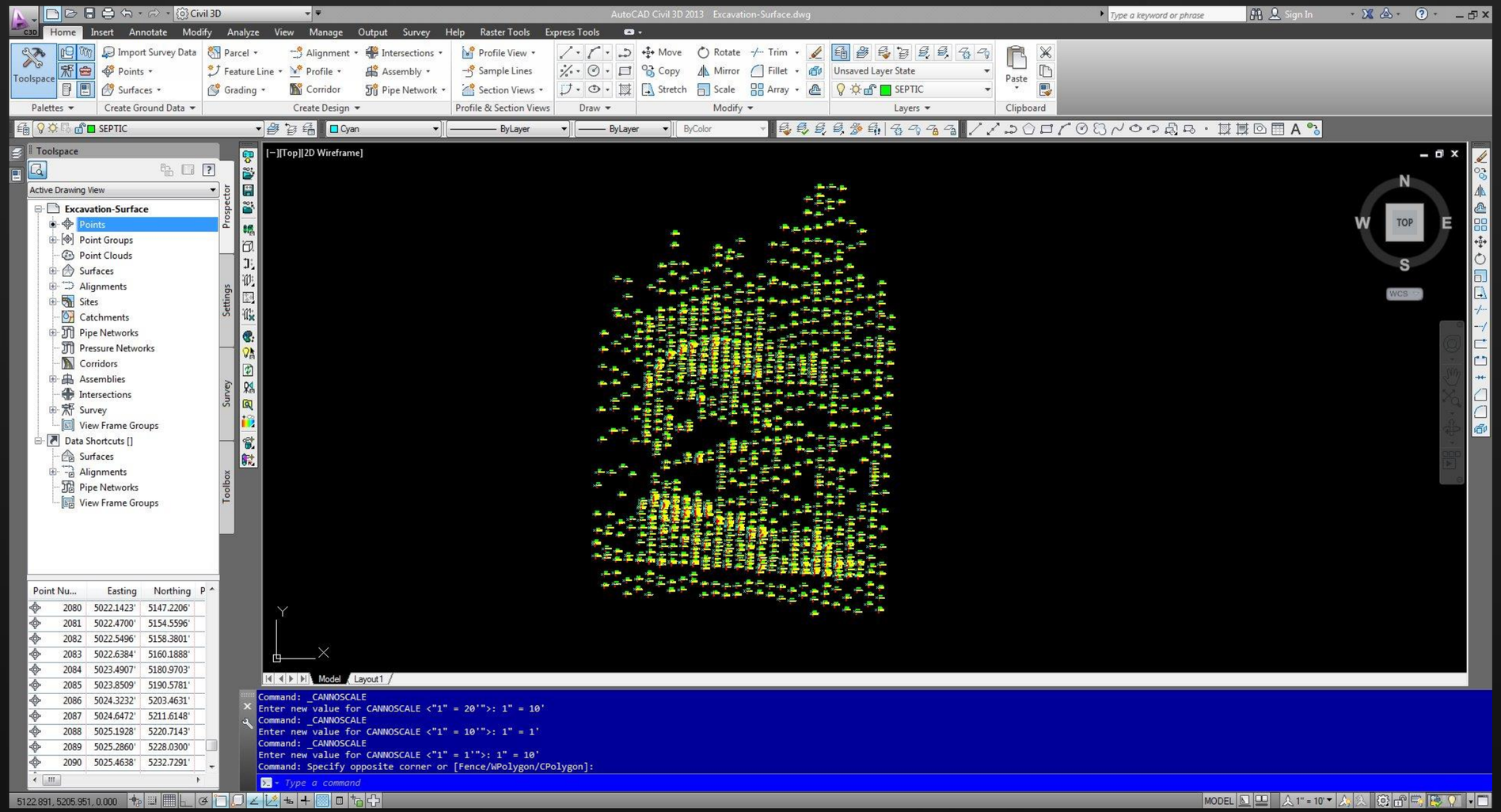
2. Virtual Survey



Using the virtual surveyor's tool in Cyclone, points are chosen directly from the point cloud. Bottom of excavation points are collected in each x-section of the alignment. Coordinate data is easily exported.

Processing Data Collected with the Leica C10 Scanner

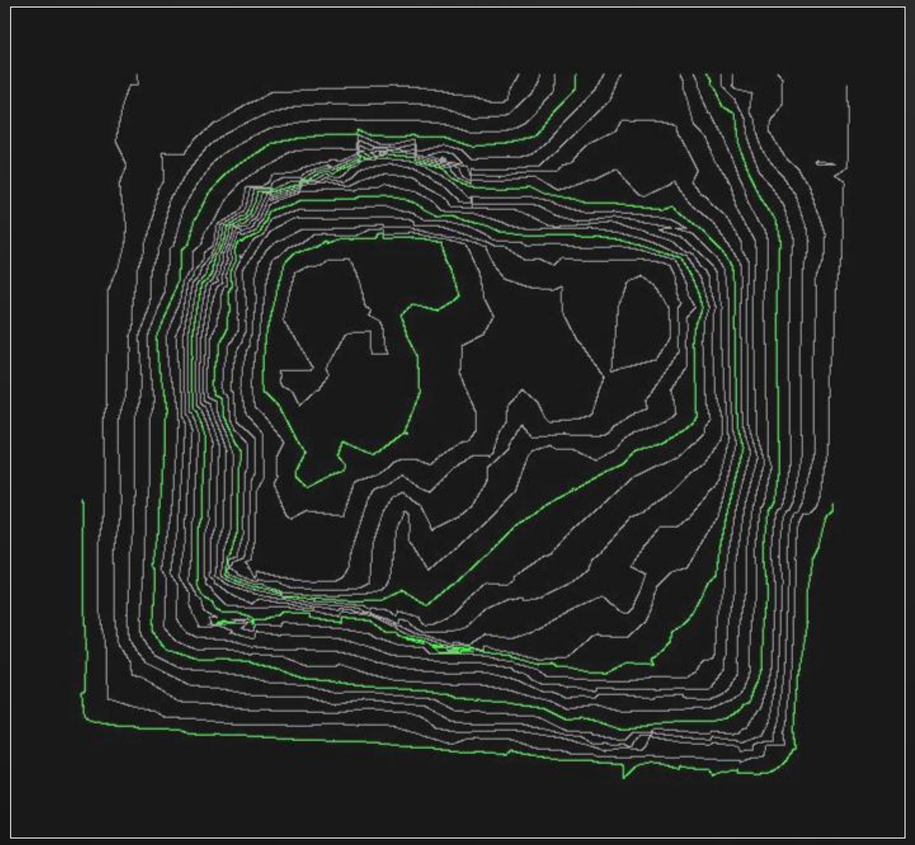
3. Import Points to AutoCAD

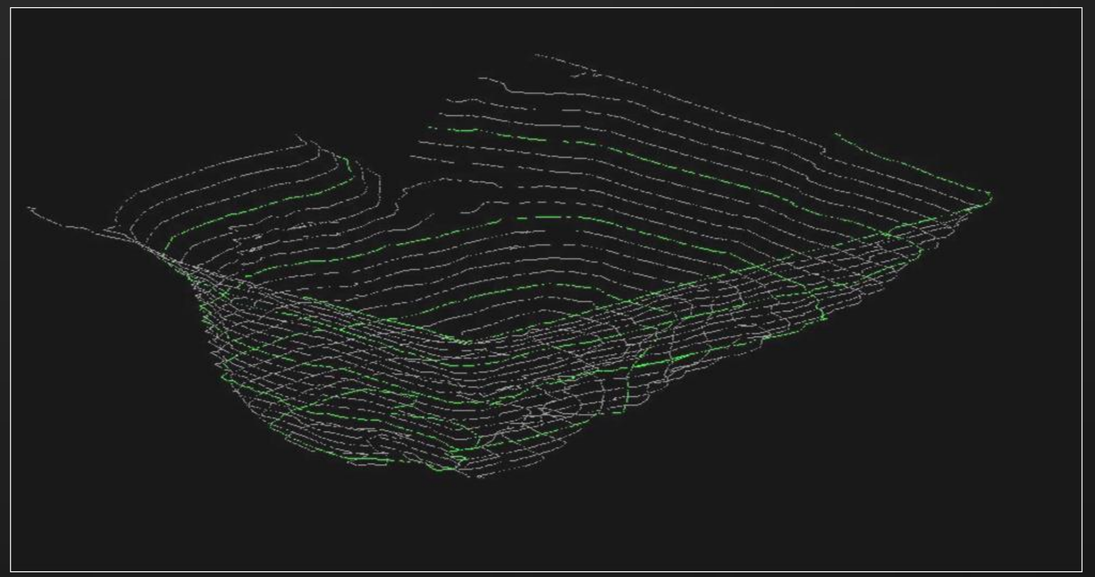


Points collected in Cyclone from the scan are imported into AutoCAD.

Processing Data Collected with the Leica C10 Scanner

4. Surface

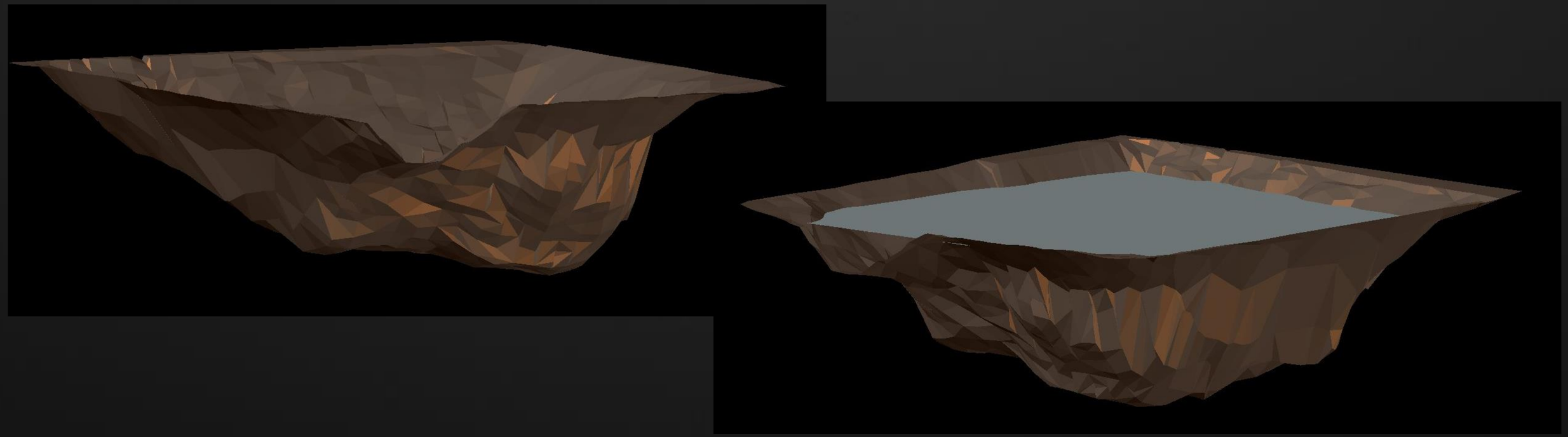




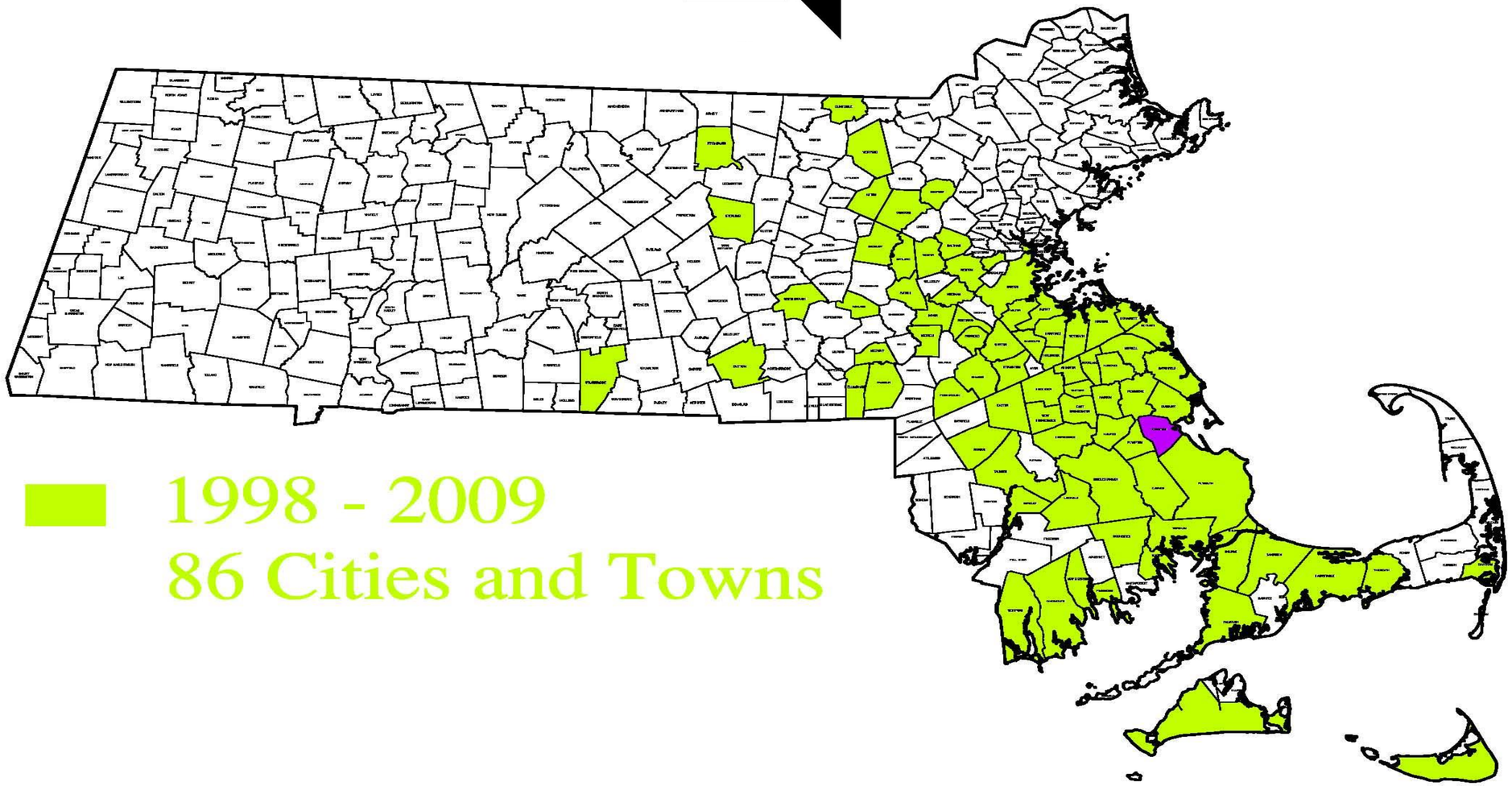
Using the virtual surveyor's tool in Cyclone, points are chosen directly from the point cloud. Bottom of excavation points are collected in each x-section of the alignment. Coordinate data is easily exported.

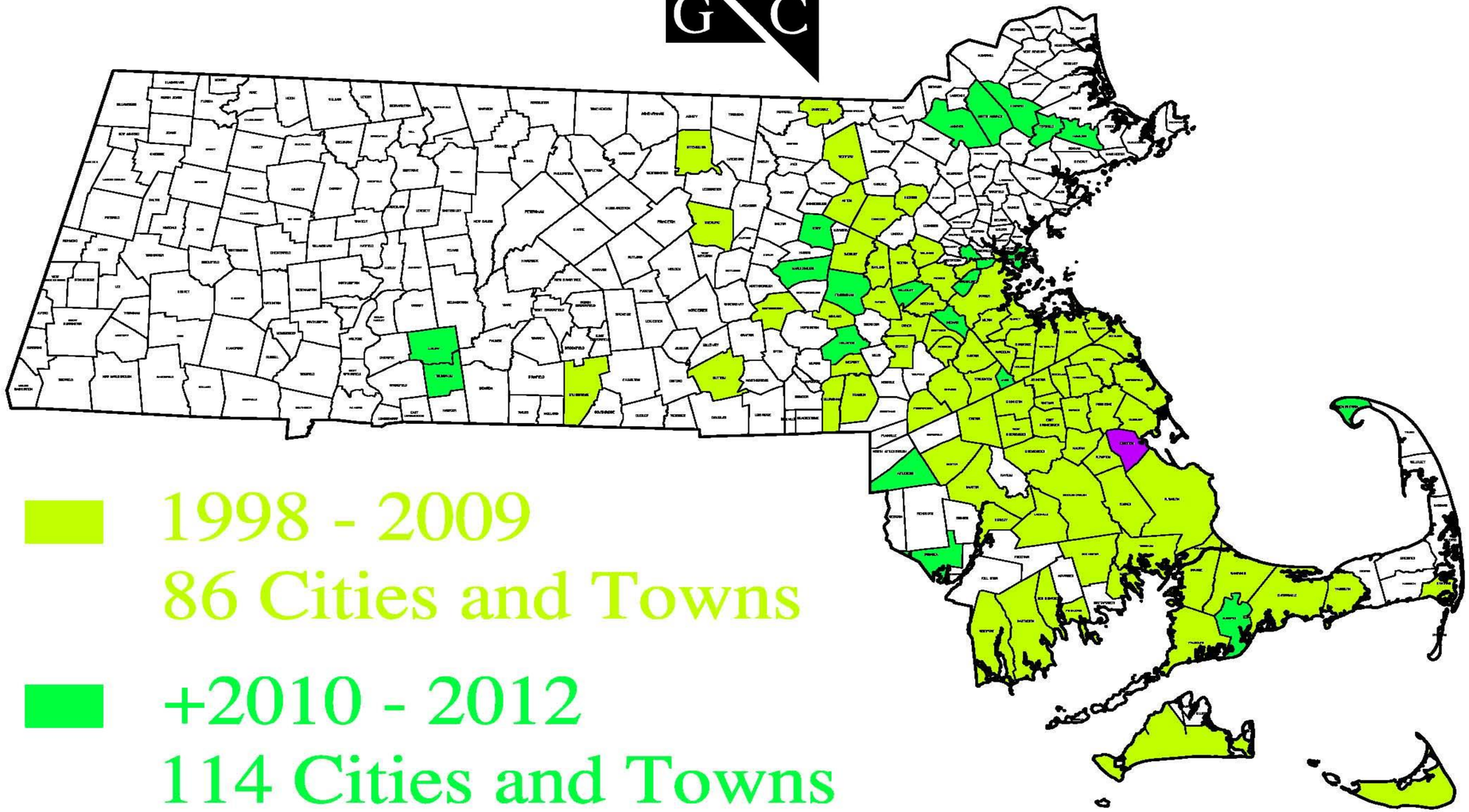
Processing Data Collected with the Leica C10 Scanner

5. Surface Volume



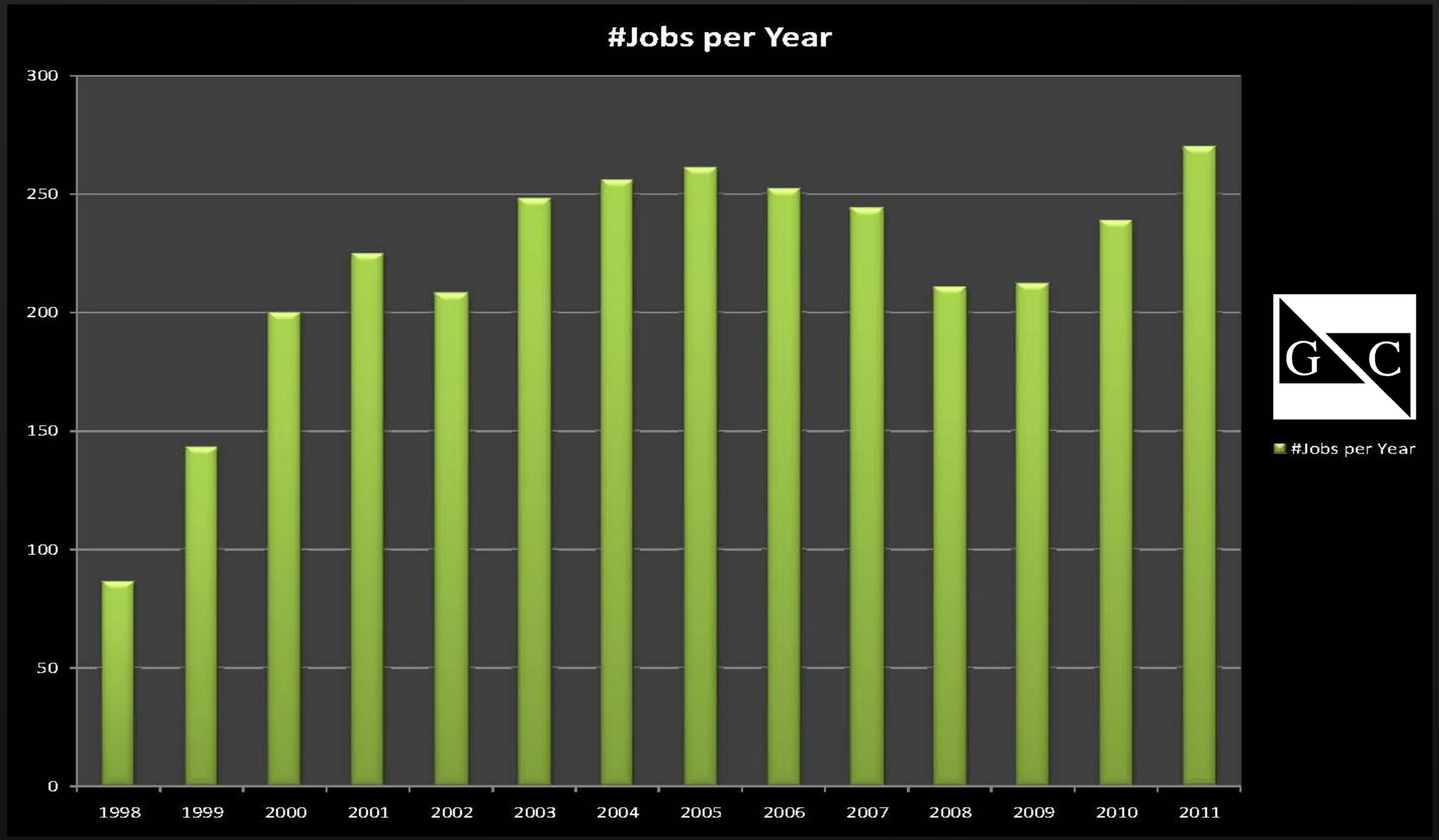
A volume surface is created by comparing the base surface (existing excavation surface) and the proposed top of sand.



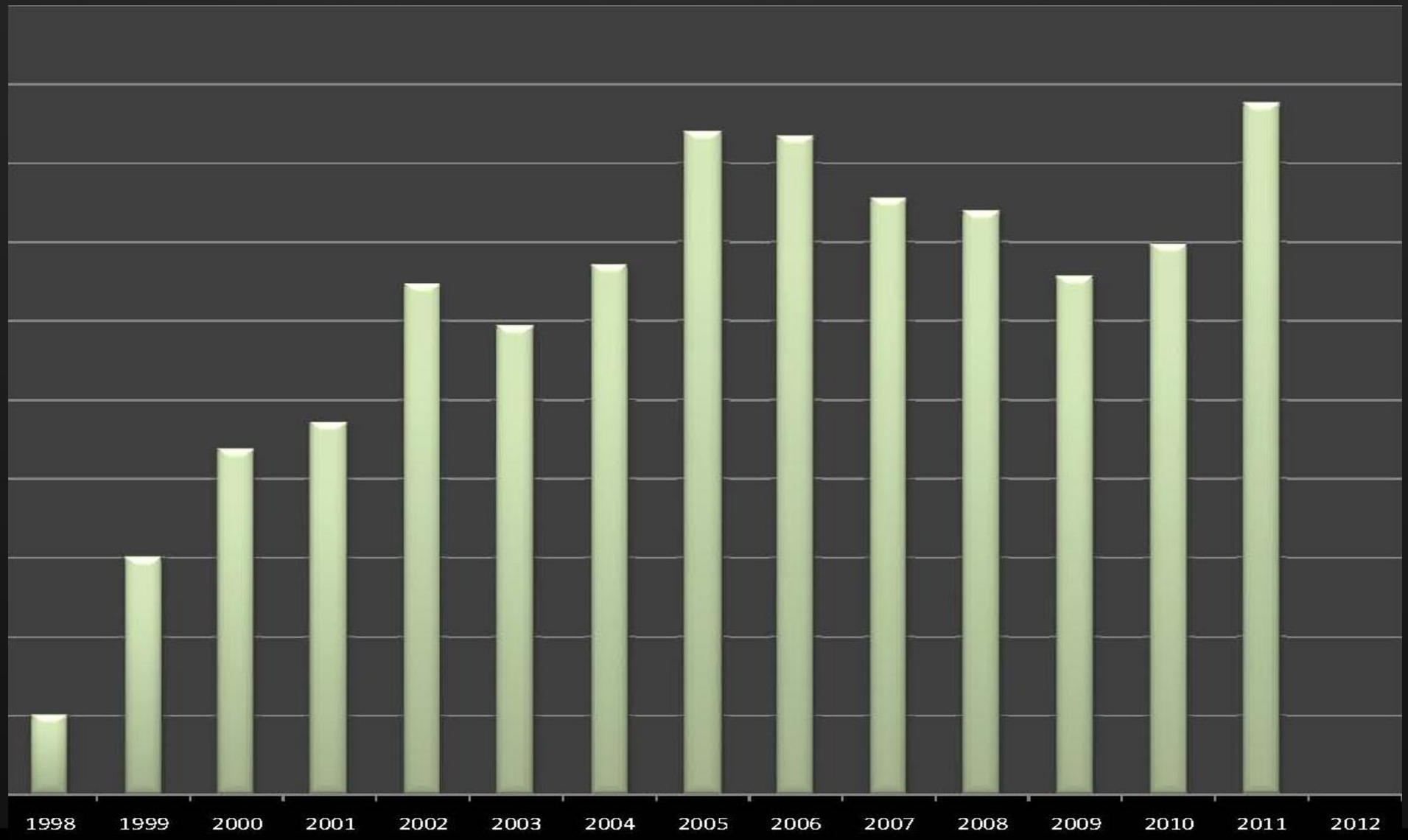


1998 - 2009
86 Cities and Towns

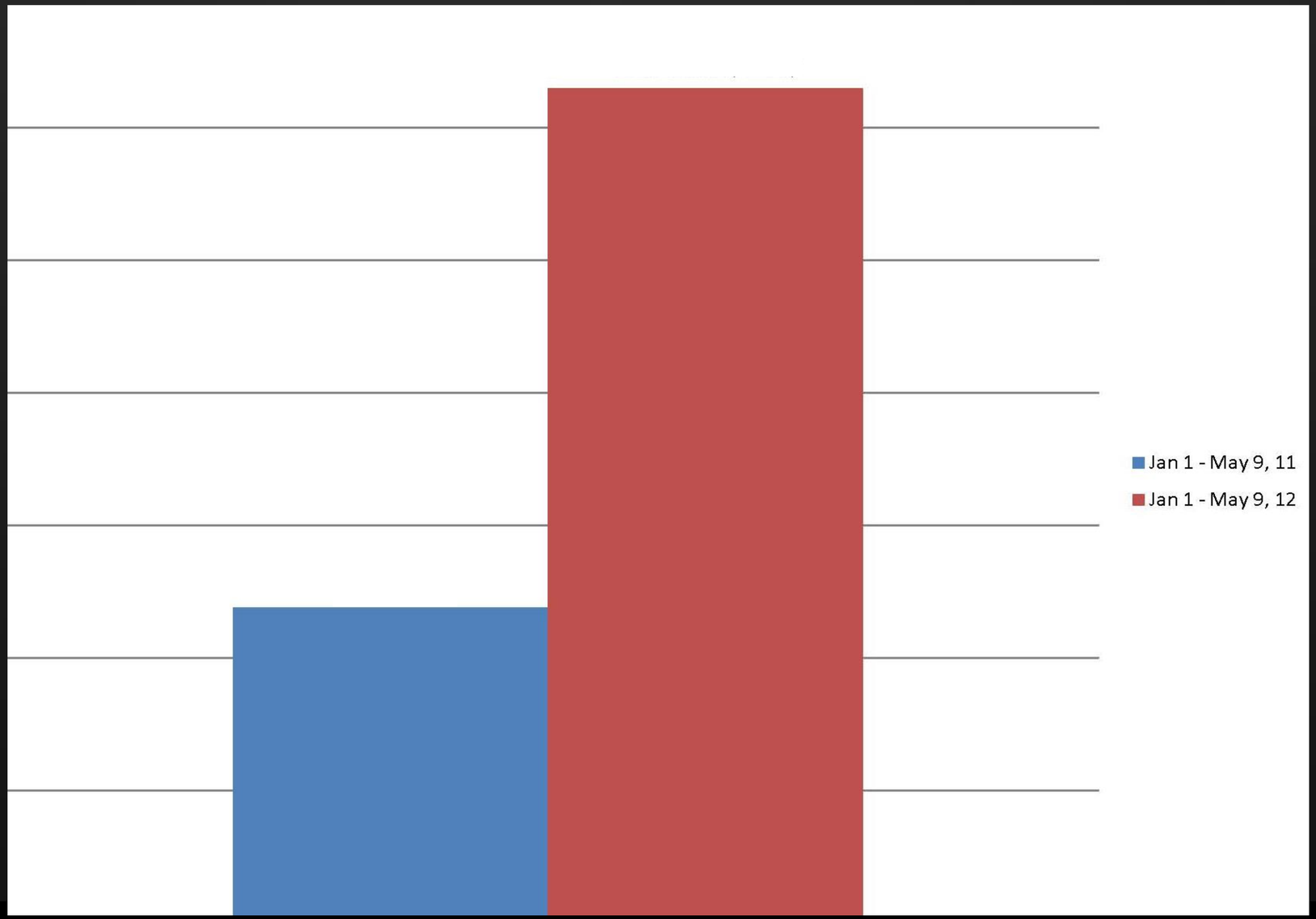
+2010 - 2012
114 Cities and Towns
(+32% Increase)

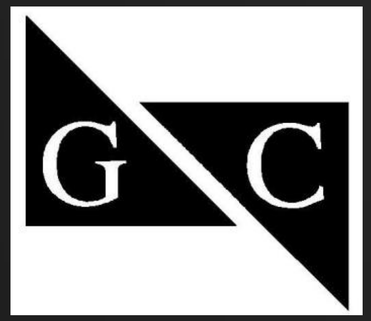


Revenue



Revenue YTD Comparison





Grady Consulting, L.L.C.

Richard Grady, President

www.GradyConsulting.com

Rick@GradyConsulting.com

Thank you!