Assessment of the Northampton Coordinate System

Prepared for the
City of Northampton
Office of Planning and Development

Wayne Feiden, Planning Director

September 22, 1997

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This report is an assessment of the condition and usefulness of the Northampton Coordinate System, the foundation for land measurement within the City of Northampton. The NCS is based on a series of about 1000 actual points ("monuments") spread throughout the city, whose positions relative to each other and to the Massachusetts Coordinate System were carefully measured in the 1950s. This network of points (the "horizontal control network") was used as the basis for Northampton's Assessors Maps and now for the City's Geographic Information System. Many boundary and topographical surveys performed within the City are tied into the NCS. City commissioned surveys are issued in NCS by contract requirement, and many private Subdivision and ANR plans are tied into the system by Planning Board regulations. The City's GPS mapping of features such as trails, wetlands, and other natural resource areas is also converted into the Northampton Coordinate System.

The City's planning and engineering functions will be more effective if more of the surveying and mapping done locally, private and public, is in fact tied into NCS. For this goal to be met, the NCS monuments and records need to be easily and economically accessible to those who produce maps and plans within the city.

The main focus of this study was on the NCS' records and monuments, but we also included a review of several large private land surveying projects and recorded monuments established by the Massachusetts DPW, to see how they might augment the NCS. The map "Horizontal Control Points" enclosed depicts the entire City, and outlines the locations of the large private surveys and state control points. The City's points are not shown.

Summary

Our study finds that the NCS is not in very good condition, particularly in the less densely populated areas of the City. Our records analysis and field reconnaissance suggests that less than one in six (perhaps 15%) of the original monuments are extant. The positional accuracy of the various points is also the subject of some concern, as noted below.

From the engineering/surveying perspective, the NCS is therefore only of marginal value when the whole City is considered. In many (perhaps most) areas of the City, land surveyors and others who need to "tie" their local measurements into the NCS are not

now able to do so without a large effort. In places where monuments or reference points are extant, mostly the urban center, the system may still be practically useful.

The City's planning needs can probably remain well served by the existing NCS and the Assessors' Maps. For planning purposes, a survey plan whose tie to the NCS is off by a few feet is still acceptable. In those situations where no tie is possible, due to the lack of nearby NCS monuments, we suggest below an alternate method for relating a survey or map to the City's Assessors' Maps and the City's GIS.

Methods

This assessment is based on analysis of the records and the actual monuments, and includes the gathering of anecdotal information from public and private individuals involved with NCS. This project's scope did not include actual measurements, so we can offer only limited comments on the measurement accuracy of the points. For this reason (and for other reasons noted below), this assessment will be of more value to the Planning Department than to the Engineering Department.

NCS Records and Monumentation

The horizontal control network is manifested today by the coordinate listings and "tie sketch" field notes filed with the DPW, and by the actual monuments remaining throughout the City. We found the records to be well kept and in good condition. The DPW's files are well organized and thorough. We photocopied all of the coordinate sheets and counted the number of monuments set (about 1000) . We copied and analyzed some 450 of the actual "tie" notes. We did on the ground reconnaissance looking for some 100 monuments in both rural and urban areas of the City.

As noted, there were originally about 1000 monuments, spread throughout the city. Each monument was a physical point (concrete bound, railroad spike, wooden stake, nail etc.) set or found at intervals of about 200-800 feet or so along the City's many roads. We estimate that only about 1 in 6 (perhaps 150 points) actually remain, and that the remaining points are mostly in the urban areas of the city.

Our records-only analysis suggests a 50% loss. Of the 468 DPW tie notes we examined, 238 monuments are either known or presumed to be lost. (The DPW's field notes record many monuments known to be lost, and we presume that all wooden hubs and nails set in pavement are very unlikely to have survived 40 years.)

Our field reconnaissance analysis suggests an even greater attrition. We looked for about 100 stone or concrete bounds (more reliable monuments), and found 6. We looked in one urban area (Prospect Street/Elm Street) and in two more rural areas (Burts Pit/Park Hill Roads and Ryan/Florence Roads. It can be assumed however, that more monuments still exist in the urban areas than our sampling suggests. Most downtown monuments were tied to still-existing building foundations, and the monument points can therefore be re-established even though the originals are now lost or destroyed. . The rural monuments are probably not reproducible, as they were tied mostly to nails set in trees, and are thus

not available. Of the few monuments found, we found even fewer intervisible pairs. Two monuments, either intervisible or fairly close to each other, are needed to tie a survey into a coordinate system.

Accuracy

When the city established the NCS, each point was assigned a coordinate (northing, easting) based on adjustments made in the office after the actual field measurements were made. Adjustments are necessary because of errors inherent in all measurements. Accurate surveying is done in loops to provide checks on measurements. The coordinates of the ending point in a loop will not be the same as the starting coordinates, even though the ending point is the same physical point as the starting point. After a given loop (a loop might include 6 city blocks) is field surveyed, the error is distributed throughout all of the individual points which make up that loop. Further adjustments are needed because a large survey such as that of the City involve multiple loops (45 loops in this case). A third level of adjustments is needed because of the earth's curvature, which becomes a measurement issue with a large area such as a city.

We understand from conversations with individuals involved with the original NCS project and DPW staff, that the second and third levels of adjustments may never have been done, or only partially completed. This is understandable considering the technology available at the time and the enormous effort it would have taken to make the adjustments. Wherever adjustments were not made, the NCS will not be accurate.

As a practical matter, assuming only adjustment errors, the deviation from true coordinates might be in the 1-5 foot range. (This number is a reasonable guess; it is not based on any mathematical analysis.) What this might mean, for example, is that the published coordinates for monuments in Florence are wrong when compared with downtown Northampton. The relative positions within Florence would all be correct under this assumption (because we assume that the Florence loop was adjusted within itself) but all points in Florence would not be correct relative to other points in the city.

While this error may not seem significant, in fact it is a problem, and will become more so for future surveying. Modern surveys can readily cover a larger area than 1950s surveys, and tend to be more accurate because of our newer tools. If, for example, a road survey were done along Locust Street, that new survey might include monuments in the downtown loop, as well as monuments in the Florence loop. The presumed error would become apparent, and would be very difficult to deal with. If the new survey includes the position of a subsurface gas line, and its position overlaps a previously surveyed water line, does that mean that the 2 lines do overlap, or is the overlap due only to the mapping error? As GPS mapping becomes less expensive, it is likely that utility companies will have their lines and facilities mapped in the State Coordinate System, and that they will give you this data in digital format. The City will need to know accurately - more so than +- 5 feet (for example) where subsurface utility lines are. As more boundary surveys are submitted to you, the overlaps and gaps caused by the errors will become quite difficult to

deal with. Also, in the future the City will be able to map any object with true coordinates very economically (with GPS receivers). The fact that the existing base map has errors, though probably relatively small errors, will become a serious problem in the future.

Private Surveys and State Control Points

Our assessment of the NCS also included limited review of several recent large surveys done in the City, and of the Massachusetts DPW's established control points. Monuments found or set during the private surveys, especially the street surveys done for the City, are supposed to be presented in the Northampton Coordinate System, and thus augment the official NCS. The state's points should serve the same purpose. Our review was of the records only; we did no field searching for the monuments. The positions of the private surveys and of the state control are shown on the "Horizontal Control Map". The state control points, where they survive, are probably quite reliable. The state points, like the city's points are well documented. Unfortunately, like the city's points, many are lost or destroyed. (Note the "N/F" (not found) notations on the coordinate list. The private surveys, while they cover large areas, are not as useful as they might be. They do not label coordinates on the plans in all cases, though the information is available with some effort. Also, while they are supposed to be tied into the NCS, they do not cite how they are tied into same, or give other indication of the accuracy of the coordinates. If, for example, a given 3000' long road survey were tied into two NCS monuments at one end only, the coordinates at the other end of the route will have inherent errors, even beyond those derived from the defects in the NCS. The shortcomings in the private surveys do not limit their value as construction surveys, but do make them difficult to use in augmenting the NCS.

Recommendations

The City should improve the Northampton Coordinate System. The lack of monuments in large areas of the city makes it impossible for surveys to be tied into the NCS without great expense. We offer several suggestions for improving the system. Options 1 and 2 below are presented for the City's selection; we offer no opinion on these expensive options. We do suggest that the city undertake the "Check Measurements" action listed under Option 2, and consider also the thorough "Compilation of Existing Monumentation" action. Information gathered from those 2 steps, especially the first one, will allow you to make a better decision as to which way to proceed.

Option 1 New Monumentation

The ideal situation for the NCS would be to have it completely redone, with new monuments set throughout the city, measured at the same time and by the same methods. The current NCS, even when augmented by state coordinates and private surveys done for the city, is not very complete. Further, since the state and private monuments were done at different times with different methods, they may result in discrepancies when used in combination, especially for the engineering functions.

The cost to establish a new, monumented GIS would be in the $90,000-$300,000 range, depending on how many monuments were set. The lower number assumes 150 pairs of monuments (300 total) at a cost of $600/pair. 150 pairs would not be enough to cover the whole city, but would be sufficient to cover most built-up areas of the city and fill in several of the rural areas where no monuments exist. This cost is not based on an actual estimate. These are very rough numbers based on our own experience with GPS surveying, and assume some assistance from the City DPW.

We do not predict when the City will discover that it needs more accurate base maps, only that the time will come. You should assume that the cost of re-monumenting the city will decline in the future, since GPS surveying (the method which would be used) is a relatively new technology, and will become less expensive as time passes.

Option 2 Recovery/Compilation of Existing Monumentation and Data

Since you have quite accurate Assessors'/GIS Maps, and we believe that the urban center of the City has a large number of the old monuments or ties extant, there is probably no near-term need to re-do the NCS, especially for the City's planning functions. The existing NCS could be thoroughly uncovered and augmented with new accurate monumentation

for significantly less cost than noted above. The results will be imperfect because the resultant coordinates will have been produced by different methods at different times. It is difficult to predict costs without more detailed information about the existing NCS.

Check Measurements

Our report suggests an error of less than five feet (perhaps as small as 1-2 feet) when monuments in one area of town are compared with those in a distant area (e.g. downtown compared to Florence). However, this supposition is based on theory, not fact such as actual measurement. The City would be well served by actually measuring between points in discreet areas. The cost of measurement and analysis of 6 points (2 downtown, 2 in Florence and 2 in West Farms area) would be about $2000.

Compilation of All Existing NCS Monumentation

A complete records analysis and field search would determine exactly how complete the NCS is today. The procedures would be similar to those we undertook for this study, but would reveal much more information. Such an inventory would be very useful in Northampton's more built up areas, where we suspect many of the original monuments and/or tie monuments are intact. The cost of this project might be in the area of $12,000. This figure assumes a search for 400 monuments, and a search rate of 10/day at a cost of $250/day. A part of this cost estimate ($2500) includes analysis of DPW data and compilation of the results of record and field research.

Compilation of Private Survey Data

A complete analysis and compilation of data from the private surveys done for the city would probably be of value to the NCS, although our limited research suggests that the resultant coordinates will pose some accuracy problems. The data reported by the private surveyors is in various formats, and not readily useable by a new mapped such as someone from the Planning Department. Most coordinates, for example, are in the NCS, which we recommend be converted into the Massachusetts state NAD83 system. The control points and boundary monuments measured on the private surveys could all be compiled onto tie sketches like those done by the DPW, with coordinates listed, and with a statement of accuracy note. The cost of doing this would probably be in the range of $1000-2000.

Prepare a Composite Map

All the coordinates produced after the compilations noted above should be stored in a computer database. Each point should have an accuracy value attached to it, based on the source and methods used to produce the coordinates. The points should be issued also on a CAD or GIS map like the Horizontal Control Points map supplied with this report.

New Monumentation in Rural Areas

As funds are available, the City can add new points to the system. The costs are not discernible at this point, but could easily approach 1/2 of the cost of the all-new monuments costs noted above.

The advantage of this "recovery" approach is a large cost savings over an entirely new set of monuments. The disadvantage, as noted above, is the lack of accuracy, and difficulty which will derive from the mixing of different measurements from different sources.

Other Recommendations

Coordinate System

We recommend that the City change its coordinate base to the Massachusetts Coordinate System, NAD83, the current standard for mapping in the Commonwealth. The existing NCS is directly related to the Massachusetts Coordinate System, NAD27, which was the standard until very recent years. NCS, for simplicity's sake, was reduced by a simple formula from the old Massachusetts system to a lower set of numbers. The new system, NAD83 is based on a different interpretation of the earth's curvature. Since it is the standard now, it should be used in Northampton. The conversion from NAD27 (or NCS) is not simple, but is easily done on a computer. CORPSCON, available from the US Army Corps of Engineers (Topographic Engineering Center, Alexandria, VA 22315-3864 (703) 355-2766) is a widely used conversion program.

Plan Standards

We recommend that all ANR and Subdivision plans be required to have a location map, oriented in the same direction as the plan itself. For those plans which are not tied into the NCS the location map should be drafted at a stated scale (eg 1" – 1000', or 1" = 400'), and should depict the nearest street intersection and the distance to same. The scaleable location map, although small, should allow the Planning Department to determine the approximate coordinates of the site via digitizing and comparing the result with the City GIS map.

All plans should have Map/Lot designations for the subject property and for all direct abutters. The lines of the abutters connecting with the subject property should be shown.

NCS Coordinates for Survey Plans

We recommend that all Subdivision plan submittals with more than 5 lots be required to include NCS coordinates, with the source and methods stated on the plan. Waivers should be permitted only in unusual circumstances. While this will be a cost burden for remote projects, the cost, about $500-$1500 per site in the worst cases, will be a relatively low amount of the overall subdivision costs.

All plans which include the NCS should state the source of the coordinates and the methods used. "Source" refers to the monuments used to bring the coordinates to the site. "Method" refers to the surveying technique used. It is important to the city to know if, for example, the coordinates produced were established by high accuracy dual-frequency GPS receivers, or, alternatively, if they are simply based on an adjoining older survey plan whose source in turn is unknown.

Enclosures

Horizontal Control Map
Coordinate List
Sample Monument Sketch
State DPW Control Map (partial)
State DPW Control Card (example)
Northampton DPW Tie Sketch (example)
Northampton DPW Coordinate Sheet (example)

1				ngp-pts.xls						
2							THESE N & E made from METRIC			
3				**Roberge Asociates Control Points**			by formula			
4							**NAD83**		**NAD27**	
5	**Point #**	**STA**		**What**	**Location**		**Northing** Y	**Easting** X	**Northing**	**Easting**
6	9001	RA-25	✓	rebar in gravel Jesse's House	West St	C	2941077.910	347421.810	n/a	
7	9002	RA-10N	✓	rebar - Pride gas station	Rt 10	C	2938392.000	345199.410		
8	9003	RA-10S	✓	rebar - Rt 10 south	Rt 10	C	2937412.050	343900.870	NAD27 is not provided for	
9	9004	RA-01	✓	rebar in grass Wilson Rd	RT 66	C	2937612.650	341032.750	Roberge Associates Control	
10	9005	RA-35	✓	10" spk near stump	Burts Pit Rd	C	2941966.570	341489.240	because the coordinates	
11	9006	RA-CB	✓	catch busin	Vernon St	C	2944514.460	342056.790	were originally derived as NAD83	
12	9007	RA-Vern	✓	rebar near sidewalk	Vernon St	C	2943891.680	344767.610		
13	9008	RA-91N	✓	State I-91	I-91	C	2949419.720	351717.230		
14	9009	RA-91S	✓	State I-91	I-91	C	2943639.010	354586.640		
15	9010	RA-RY31	✓	rebar in grass opp store	Ryan Rd/Sylv	C	2939964.020	327457.080		
16	9011	RA-RY2	✓	pk in walk near school	Ryan Rd	C	2943672.790	333782.980		
17										
18										
19										
20				**State Control Points**						
21										
22				I-91						
23										
24	Point #	STA		What	Location		Northing	Easting		
25	9501	185QQ	✓	mags disc in conc mon at grad	I-91		2932887.241	351255.331	<== these numbers are	
26	9502	185RR	✓	mags disc in conc mon at grad	I-91		2934984.891	350608.974	computed from the DPW	
27	9503	185SS	✓	mags disc in conc mon at grad	I-91		2936928.962	350927.517	supplied metric #s ==>	
28	9504	185TT	✓	mags disk in conc end post	I-91		2939391.053	352552.192		
29	9505	185UU	✓	mags disk in conc mon at grad	I-91		2941621.774	354028.590		
30	9506	185VV	✓	mags disk in conc mon at grad	I-91		2943639.011	354586.640		
31	9507	185WW		NOT SUPPLIED BY DPW	I-91		0.000	0.000		
32	9508	185XX	✓	mags disc in conc mon down	I-91		2949419.724	351717.230		
33	9509	185YY	✓	mags BM disk on SE end post	I-91		2951101.529	348569.375		
34	9510	185ZZ	✓	mags disc in conc mon at grad	I-91		2953009.287	347296.661		
35	9511	186A	✓	mags disc in conc mon at grad	I-91		2954716.767	347585.246		
36	9512	186B	✓	mags disc in conc mon at grad	I-91		2955830.971	348248.946		
37	9513	186C	✓	mags disc in conc walk at gra	I-91		2958419.844	349101.562		
38										
39										
40				B&M / NYNHRR						
41										
42	9514	9U	✓	mag disk in conc mon up 2"	B&M RR		2944500.577	350498.974		
43	9515	9V	✓	mags disk in conc mon up 3"	NYNHRR		2943660.828	351068.445	<== these numbers are	
44	9516	9W	✓	mags disk in conc mon 12" be	B&M RR		2942416.897	351978.833	typed in directly from	
45	9517	9Y	✓	mags disk in conc mon	B&M RR		2936368.018	352907.716	the DPW supplied cards	
46	9518	F-5	✓	disk in conc mon up 2.2'	B&M RR		2933794.618	353502.879		
47	9519	LAFLEUR	✓	mags disk on end post	n/a		2946386.600	355748.929		
48	9520	LAFLEUR	✓	mags disk	n/a		2946355.715	354274.613		
49	9521	9T		NOT FOUND	NYNHRR		0.000	0.000		
50										
51										
52										
53				RT 5						
54										
55	9522	9N		N/F ?? 1959	RT 5		0.000	0.000		
56	9523	9Q		N/F 5/82	RT 5		0.000	0.000		
57	9524	API29		N/F 5/82	RT 5		0.000	0.000		
58	9525	API30		N/F 5/82	RT 5		0.000	0.000		
59	9526	DA		N/F 5/82	RT 5		0.000	0.000		
60	9527	DA-1		N/F 5/82	RT 5		0.000	0.000		
61										
62										

63									
64				Rt 10s					
65									
66	9528	EX-10		N/F 5/82	Rt 10s	0.000	0.000		
67	9529	EX-11		N/F 5/82	Rt 10s	0.000	0.000		
68	9530	EX-12		N/F 5/82	Rt 10s	0.000	0.000		
69	9531	EX-13	✓	top of fire hydrant	Rt 10s	2937344.059	343779.576	476681.170	287478.020
70	9532	EX-16	✓	top of fire hydrant	RT 10	2938803.710	346406.350	478140.780	290104.810
71	9533	EX-17		N/F 5/82	Rt 10s	0.000	0.000		
72									
73									
74				Nonotuck St / Rt 9 / Burts Pit Rd					
75									
76	9534	EY-11		N/F 5/82	Burts Pit Rd	0.000	0.000		
77	9535	EY-12		N/F 5/82	Burts Pit Rd	0.000	0.000		
78	9536	EY-22		N/F 5/82	Florence Rd	0.000	0.000		
79	9537	EY-23		N/F 5/82	Florence Rd	0.000	0.000		
80	9538	EY-30		N/F 5/82	Nonotuck St	0.000	0.000		
81	9539	EY-31		N/F 5/82	Nonotuck St	0.000	0.000		
82	9540	EY-34		NOT SUPPLIED BY DPW	Rt 9 & Locust	0.000	0.000		
83	9541	EY-35	✓	ip flush in ground	Rt 9 & Locust	2947726.660	344651.620	487063.780	288350.090
84									
85									
86				Rt 66				293648.492	337524.997
87									
88	9542	N-13	✓	ip flush in ground	Rt 66	2939250.088	343953.572	478587.200	287652.020
89	9543	N-14	✓	ip flush in ground	Rt 66	2938659.959	342794.359	477997.090	286492.800
90	9544	N-19		N/F 5/82	Rt 66				
91	9545	N-20	✓	ip flush in ground	Rt 66	2936848.492	337524.997	476185.710	281223.410
92	9546	N-23		N/F 5/82	Rt 66				
93	9547	N-24		N/F 5/82	Rt 66				
94	9548	N-27	✓	ip flush in ground	Rt 66	2935283.186	325988.091	474620.600	269686.450
95	9549	N-28	✓	ip flush in ground	Rt 66	2934807.859	325517.363	474145.280	269215.720
96	xx	N-38		N/F 5/82	Rt 66				
97									
98				Bridge Rd					
99									
100	9550	AP-119		N/F 5/82	Bridge Rd	0.000	0.000		
101	9551	AP-118		N/F 5/82	Bridge Rd	0.000	0.000		
102	9552	DA-9		N/F 5/82	Bridge Rd	0.000	0.000		
103	9553	AP-101		N/F 5/82	Bridge Rd	0.000	0.000		
104	9554	AP-102		N/F 5/82	Bridge Rd	0.000	0.000		
105	9555	DA-10	✓	copper weld in ground	Rt 9 / Bridge Rd	2952505.076	337030.863	491842.340	280729.290
106	9556	AP-92		N/F 5/82	Rt 9 (off)	0.000	0.000		
107	9557	AP-91		N/F 5/82	RT 9 (off)	0.000	0.000		
108	9558	A-185K	✓	mags disc in ledge at grade	RT 9	2961248.936	334219.414		
109									
110									
111				Hockanum Rd					
112									
113	9559	9YA		NOT SUPPLIED BY DPW		0.000	0.000		
114	9560	9YB		NOT SUPPLIED BY DPW		0.000	0.000		
115									
116									
117				Damon Rd					
118									
119	9561	DA11		NOT SUPPLIED BY DPW		0.000	0.000		
120	9562	AP141		NOT SUPPLIED BY DPW		0.000	0.000		
121	9563	AP142		NOT SUPPLIED BY DPW		0.000	0.000		

City of Northampton
GIS Monumentation Record

Location and Coordinates of Monuments used for the Geographic Information System

Monument Number/Name: RA-GPS-9002

Location

Street(s): Route 10 Near: Pride Gas Station

Description: spike in grass, in island, 7' off road pavement

Source

Monument Set By: Roberge Associates

Surveying Method: ✓ GPS ___ Ground Survey

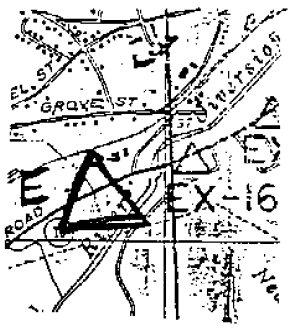
Date Set: Spring, 1995

Source Document/Plan: Roberge Associates Records

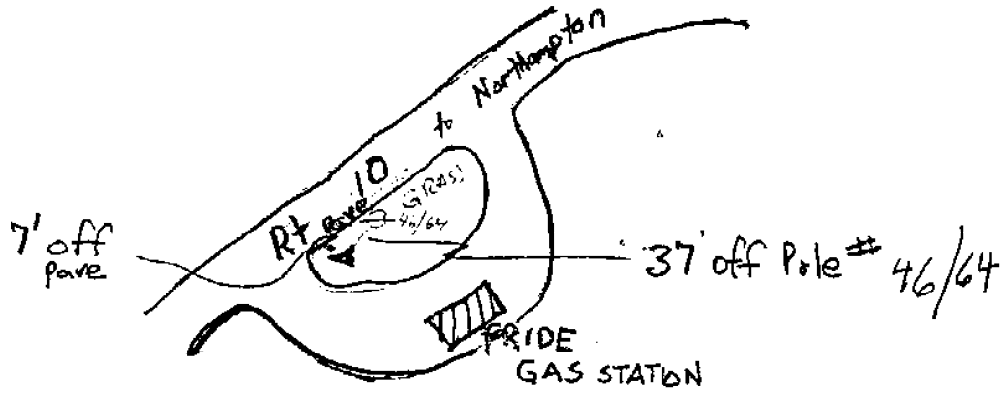
Coordinates: North (Y): ___

NAD83 East (X): ___

Quality: High quality - GPS closed traverse



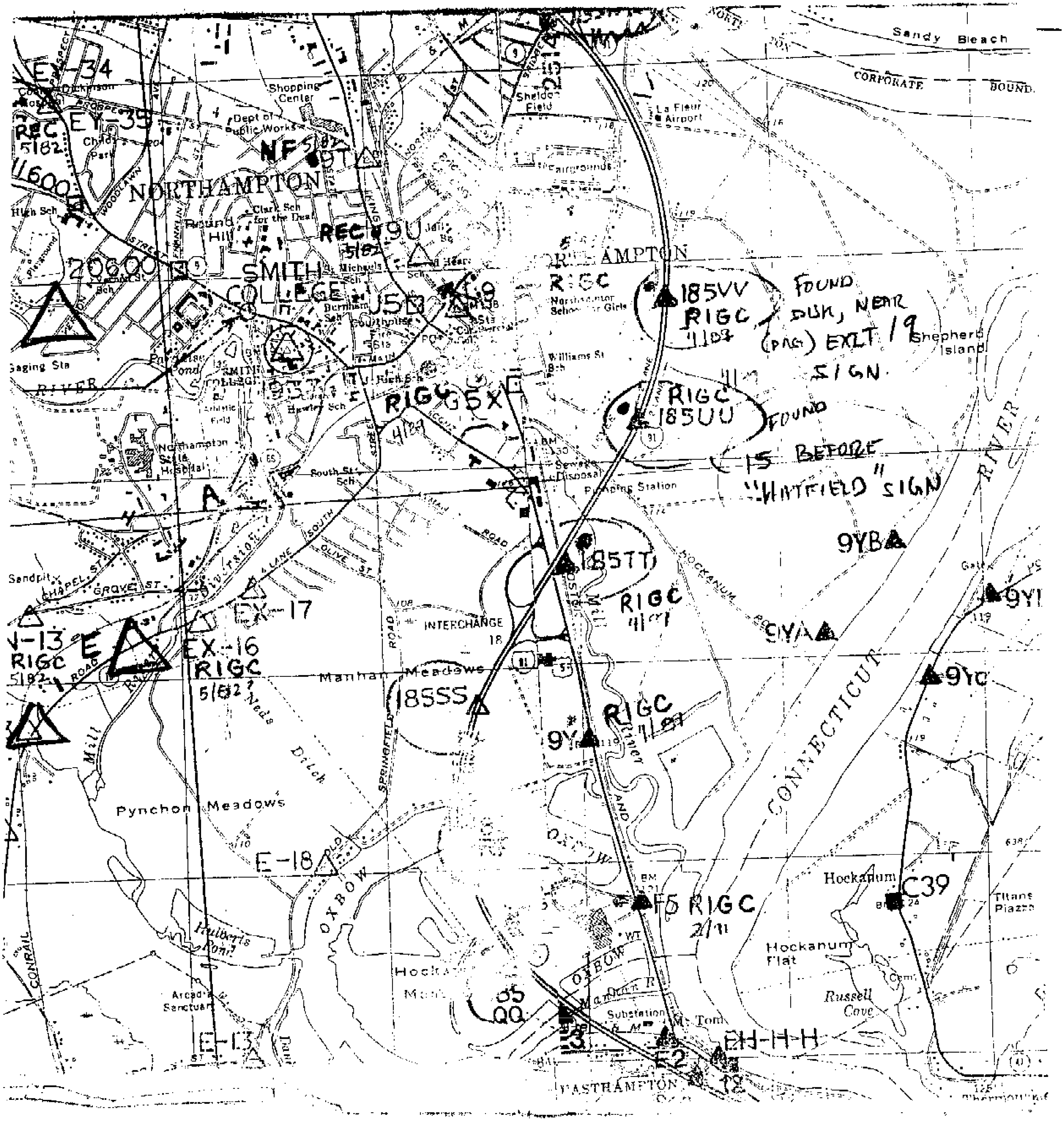
LOCATION MAP



TIE SKETCH

Notes By: ___ Date: ___

Sample Monument Sketch



State DPW Control Map (partial)

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS
GEODETIC SURVEY

EASTHAM FROM Q

FORM No. G-11

TRAVERSE DATA

STATION N-13 (John Weiler & Asso.)

2.	3.

CITY-TOWN Northampton PROJECT NO.

X-COORD. 287 652.02' E

Y-COORD. 478 587.20' N

1927 NORTH AMERICAN DATUM

ELEV.

SEA LEVEL DATUM OF 1929

DISTANCES AND DIRECTIONS TO OBJECTS OBSERVED

OBJECT	DISTANCE	GRID AZIMUTH
N-14 Rocky Hill (66) [illegible]	1300.77'	63 01 17
42° 18' 27.23572"		
72° 39' 16.99092"		

NAL [illegible]

DETAILED DESCRIPTION

From the intersection of Routes 9 & 66 in Northampton, proceed southwesterly along Route 66 for approximately 1.3 miles to station. Station is an iron pin set flush with the ground on north side of Route 66.

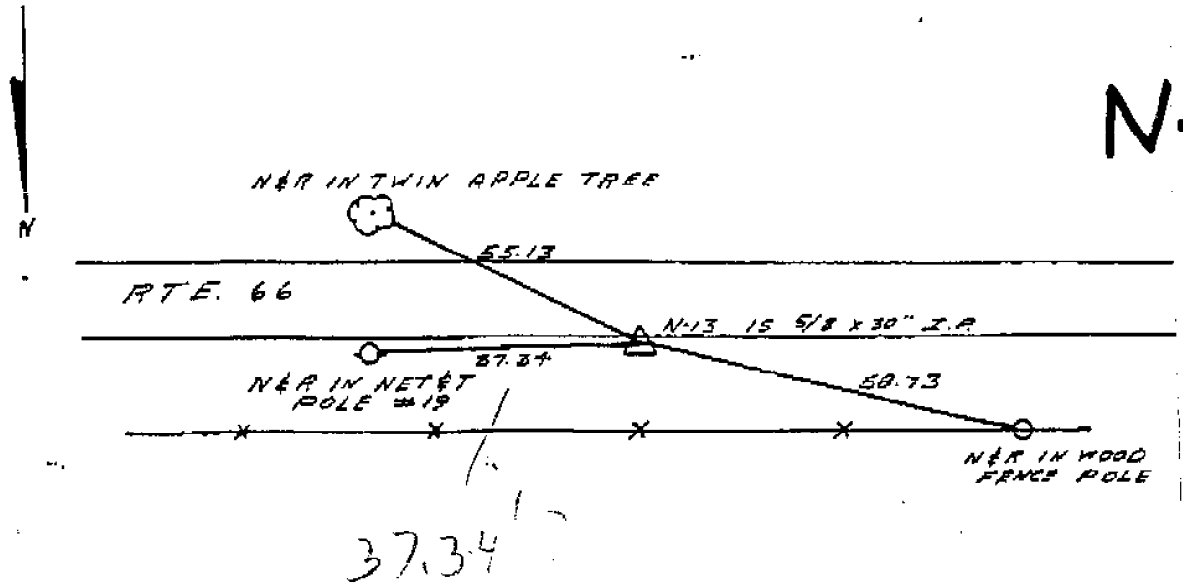
ADJUSTED 1967 RIGC 5/82 RECOVERED C2-20 P

2 (N-13)	478587.20000 N	2939250.08762 N
	287652.02000 E	343953.57210 E
Convergence	-00 46 32.36992	-00 46 31.24551
Scale Factor	0.999966288	0.999966289

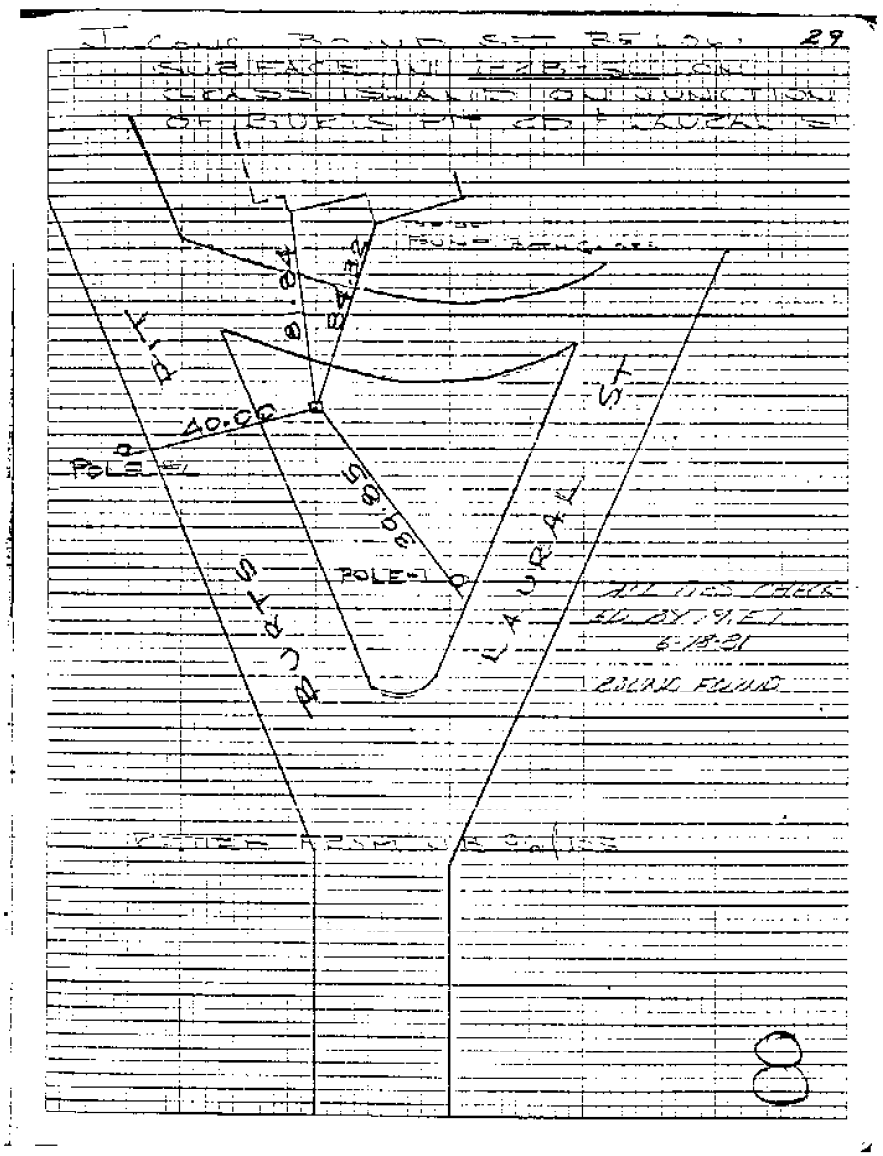
Grid Shift(US Ft), Delta North = 2460662.888
Delta East = 56301.552

Datum Shift(m), Delta Lat. = 9.972
Delta Lon. = -38.340

N-13



State DPW Control Card (example)



Northampton DPW Tie Sketch (example)

CONTROL #14 (42) (13)

29 points

COORDINATE SHEET

(Note: Based on mass Grid, except 264,000 subtracted from X's 469,700 " " Y's

(from Control #2) (2 Q):	(x = 24,605.138)	(y = 17,311.094)
P 14 A:	x = 24,312.632 ~~652~~ .20	y = 17,522.160 ~~160~~ .06
P 14 B:	x = 24,081.477 ~~529~~ .32	y = 18,048.680 ~~665~~ .07
P 14 C:	x = 23,927.270 ~~354~~ .32	y = 18,587.277 ~~253~~ .09
P 14 D:	x = 23,873.561 ~~683~~ .38	y = 19,252.065 ~~030~~ .11
P 14 E:	x = 23,812.508 ~~650~~ .20	y = 19,605.074 ~~033~~ .6
P 14 F:	x = 23,495.194 ~~873~~ .37	y = 20,172.573 ~~524~~ .11
P 14 G:	x = 22,909.679 ~~896~~ .38	y = 20,492.813 ~~750~~ .11
P 14 H:	x = 22,740.010 ~~238~~ .11	y = 20,598.798 ~~731~~ .4
P 14 I:	x = 22,372.498 ~~755~~ .29	y = 20,963.924 ~~849~~ .8

Northampton DPW Coordinate Sheet (example)

Click on the entry to go to the corresponding page.

RA-25

RA-10N

RA-10S

RA-01

RA-35

RA-CB

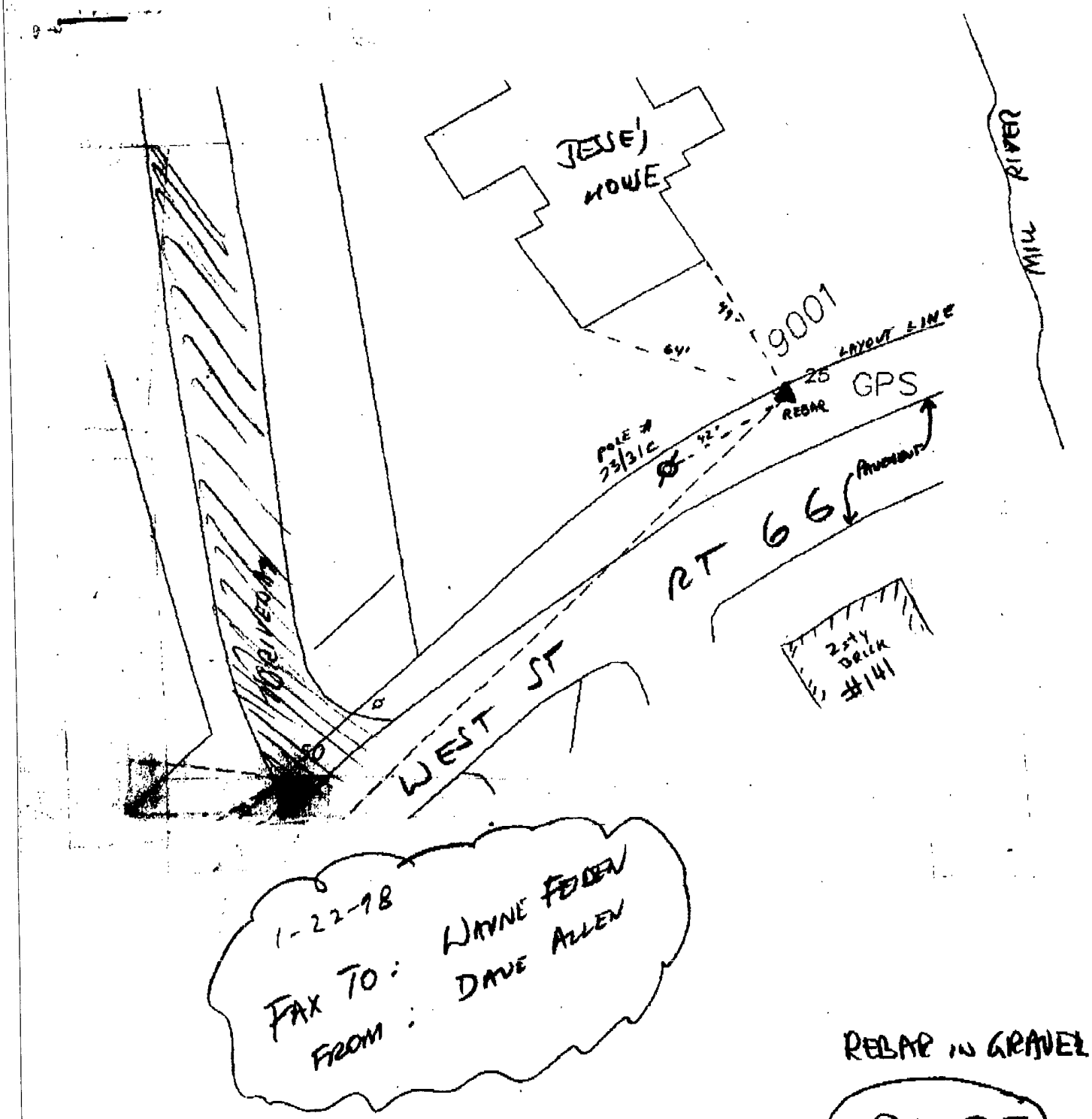
RA-VERN

RA-91N

RA-91S

RA-RY31

RA-RY2



1-22-98
FAX TO: WAYNE FEDEN
FROM: DAVE ALLEN

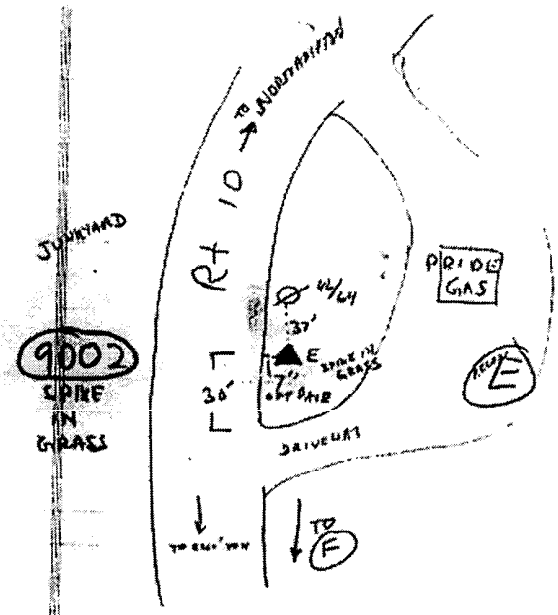
REBAR IN GRAVEL

RA-25

ASH TIES

ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL P O BOX 4000
GREENFIELD, MASSACHUSETTS 01302
(413) 772-2801

FIELD △ 29
GPS △ 900



ROUTE 10 @ GAS STATION

GPS RECON E
GPS STATION 2
GPS COMP 9002
FIELD Δ N/A

SPIKE SET

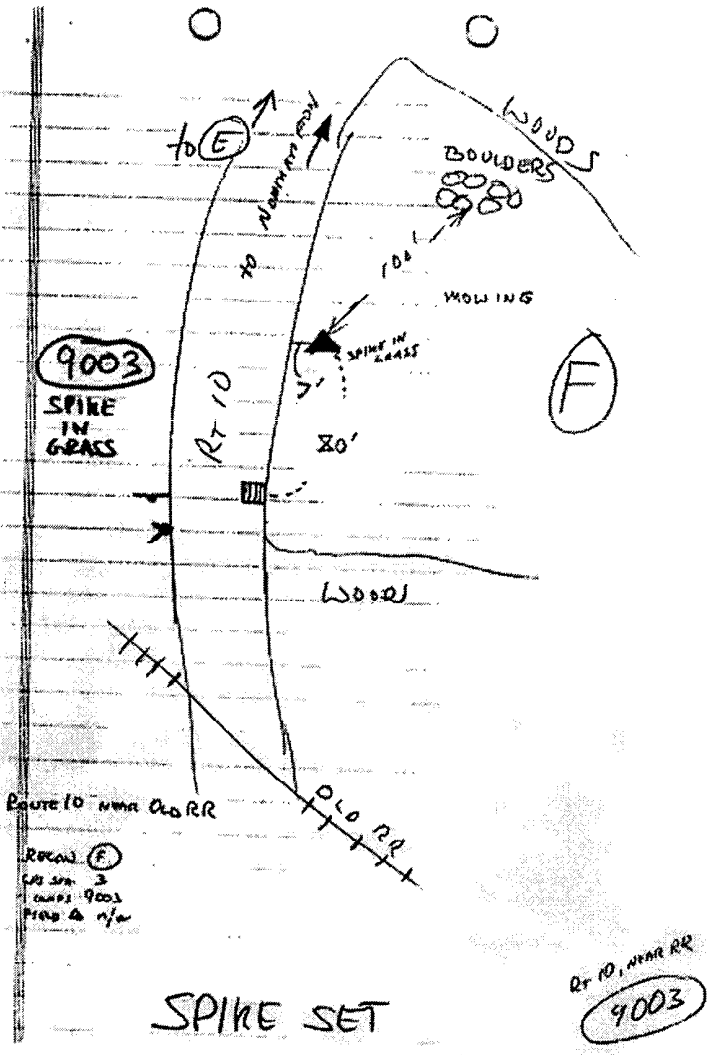
PRIDE GAS STA. 9002

9000 = GPS #S

RA-10N

ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL #283
GREENFIELD, MASSACHUSETTS 01301-3252
(413) 772-2801

9002

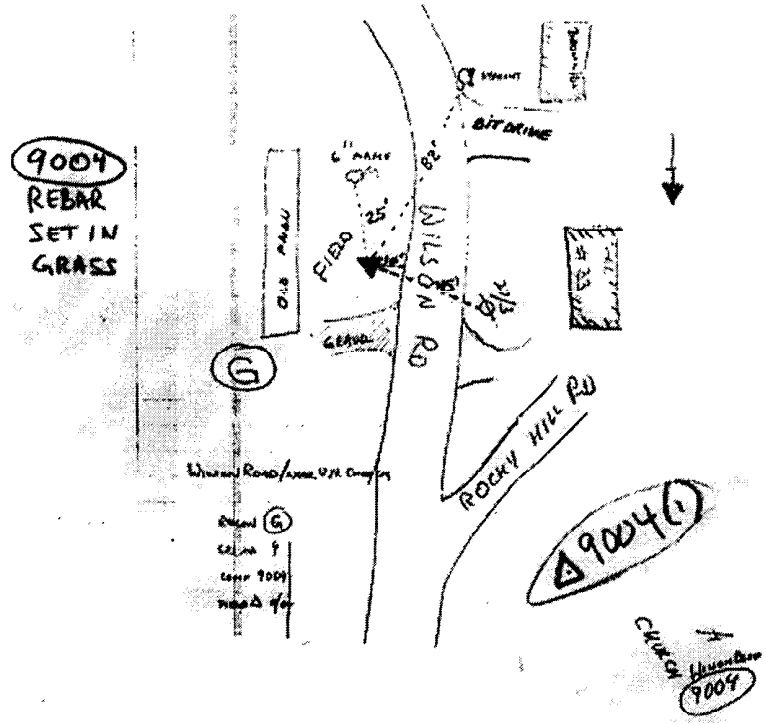


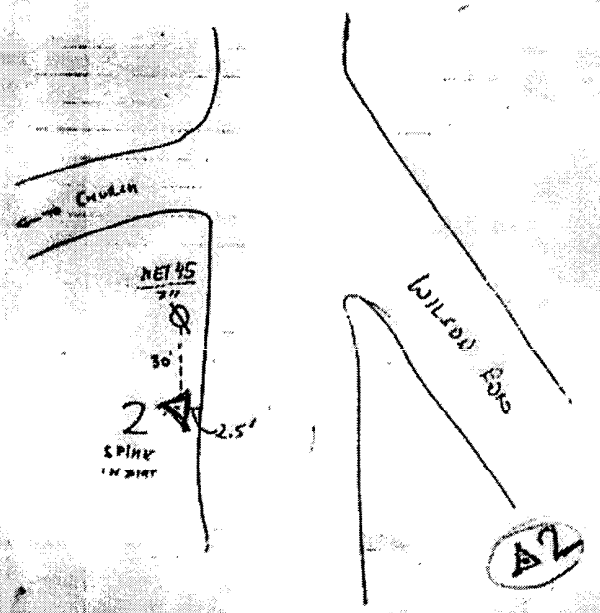
SPIKE SET

ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL #283
GREENFIELD, MASSACHUSETTS 01301-3252
(413) 772-2801

RA-10S

9003



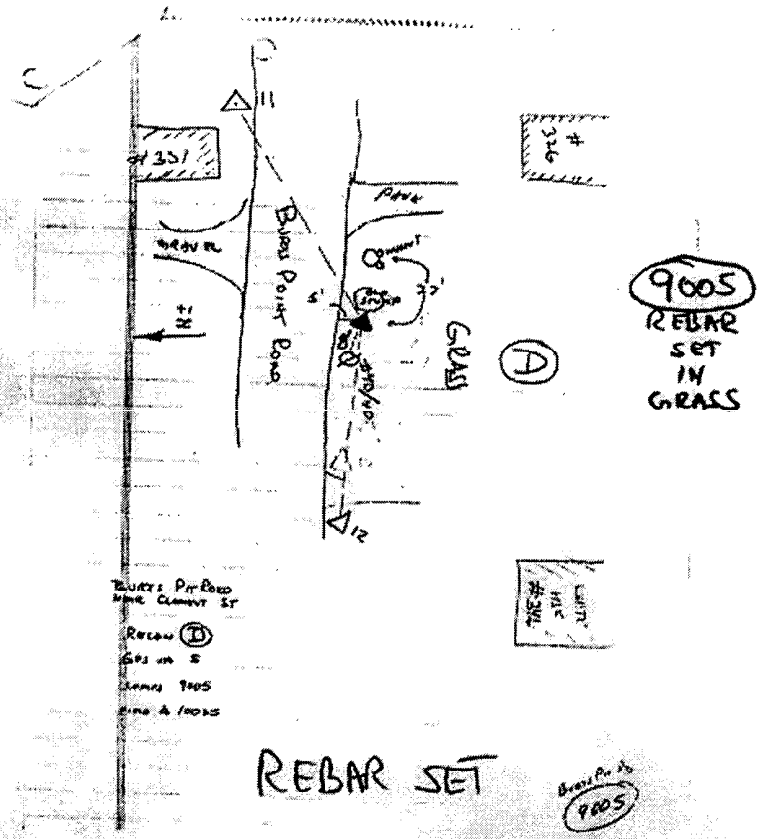


ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL #283
GREENFIELD, MASSACHUSETTS 01301-3252
(413) 772-2801

RA-01

Δ 9004 (1)

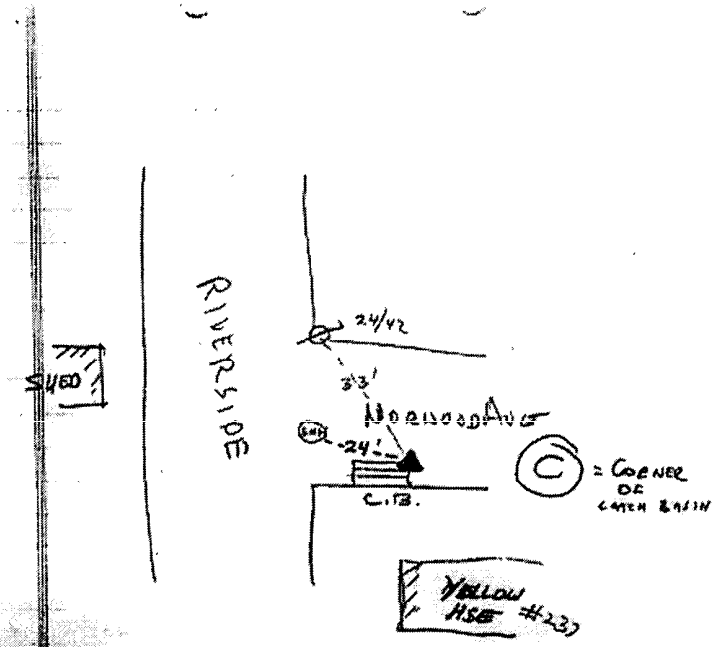
Δ 2



ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL #283
GREENFIELD, MASSACHUSETTS 01301-3252
(413) 772-2801

RA-35

9005



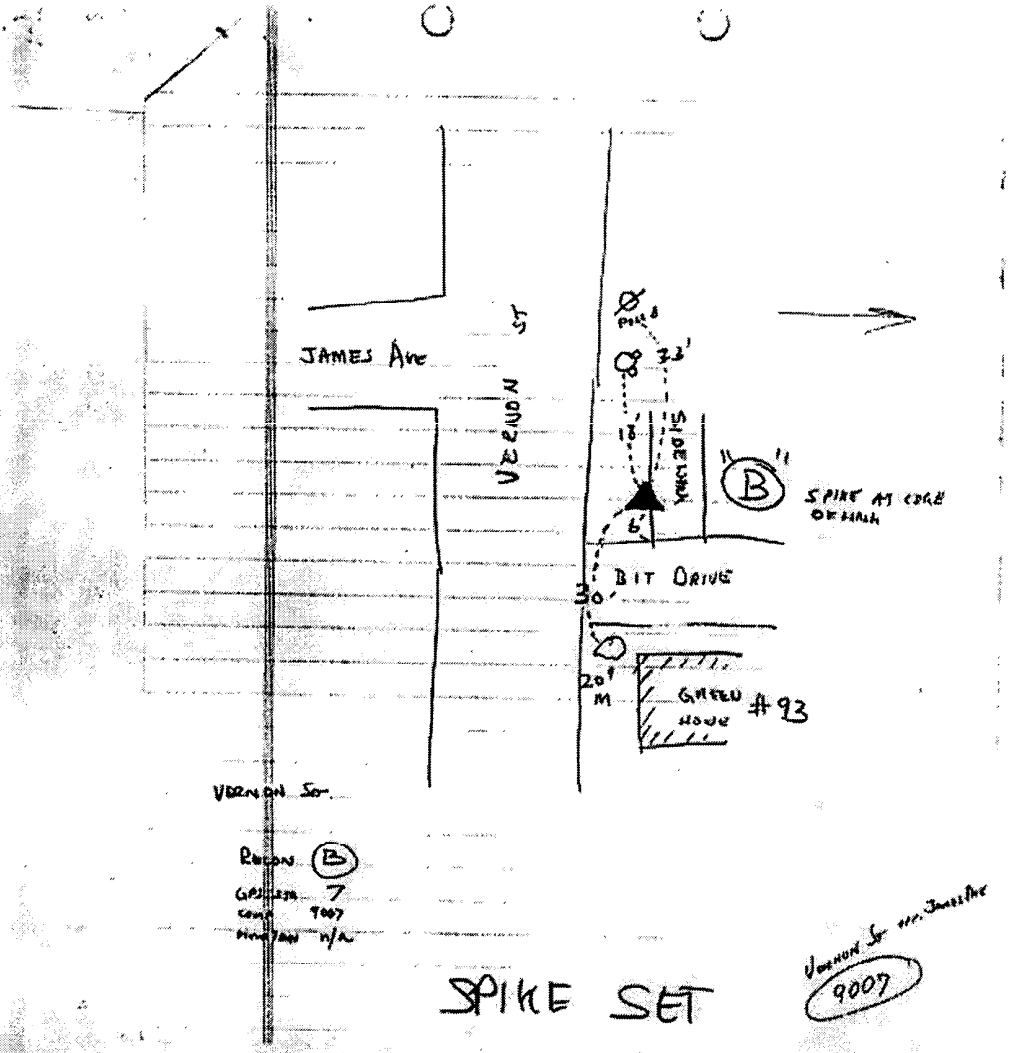
CATCH BASIN CORNER

9006

ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL #283
GREENFIELD, MASSACHUSETTS 01301-3252
(413) 772-2801

RA - CB

9006



SPIKE SET

Vernon St nr. James Ave

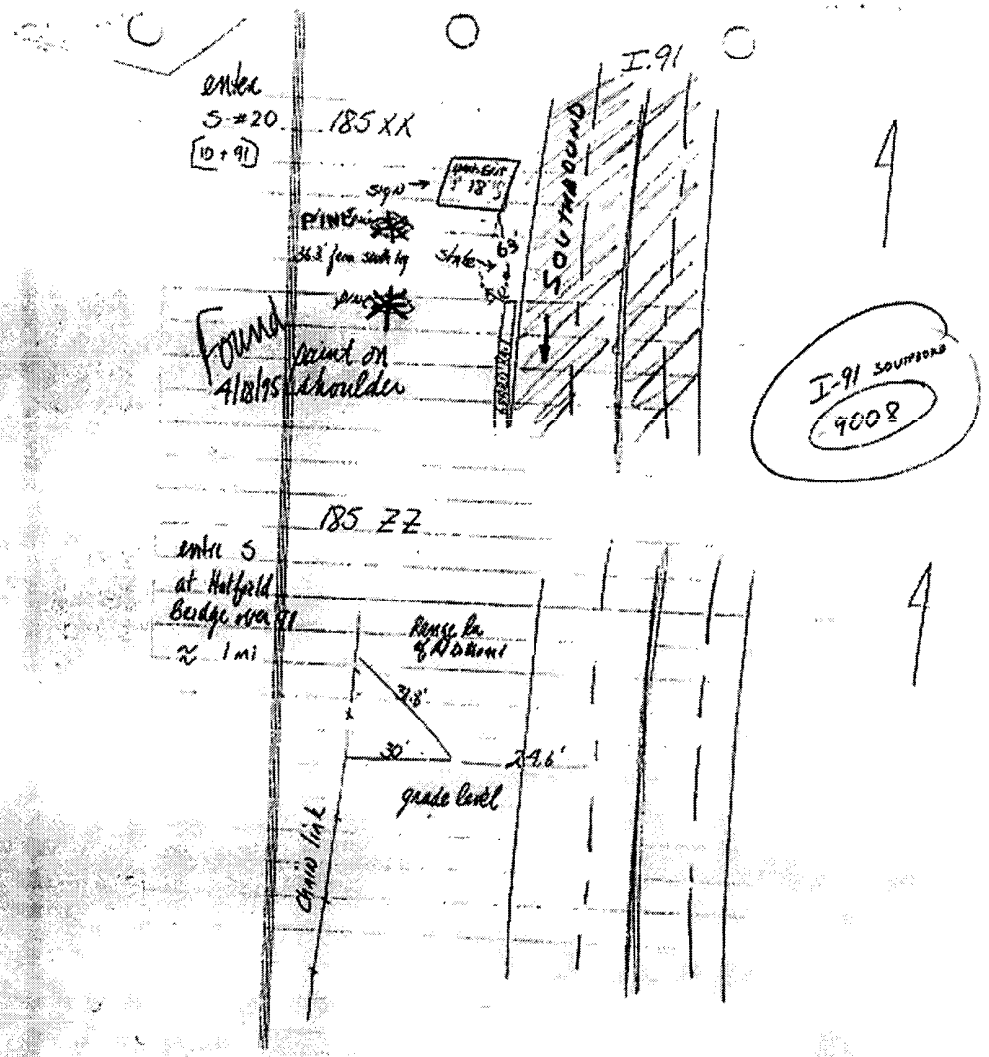
9007

(? did this change?)

ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL #283
GREENFIELD, MASSACHUSETTS 01301-3252
(413) 772-2801

RA-VERN

9007

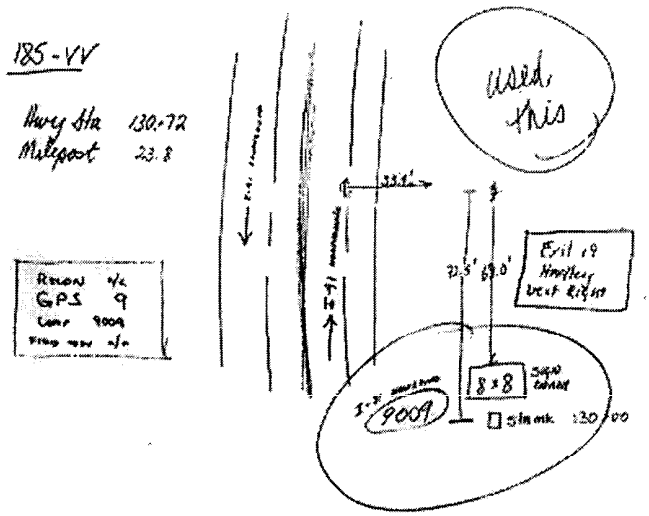


?

ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL #283
GREENFIELD, MASSACHUSETTS 01301-3252
(413) 772-2801

RA-91N

9008

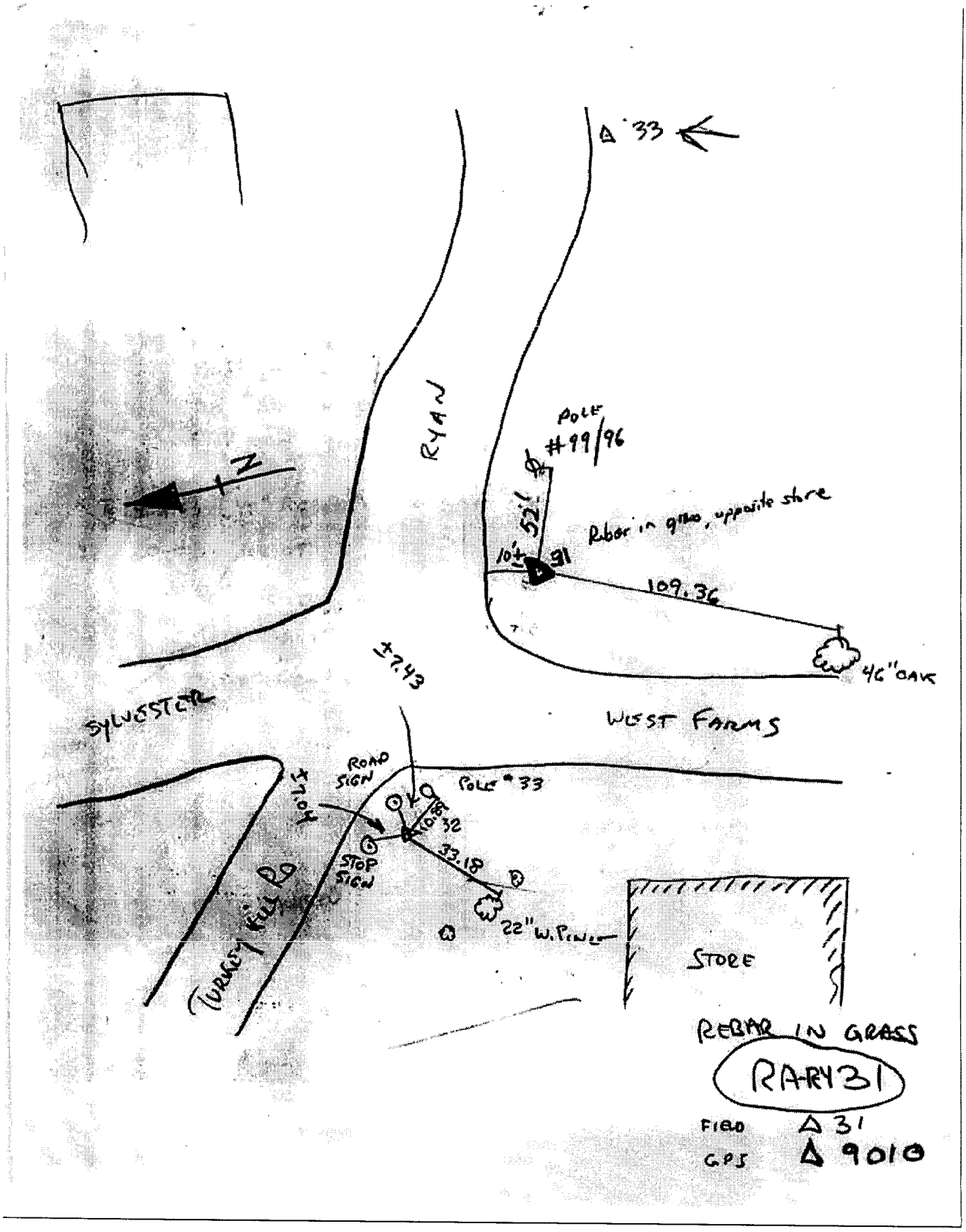


?

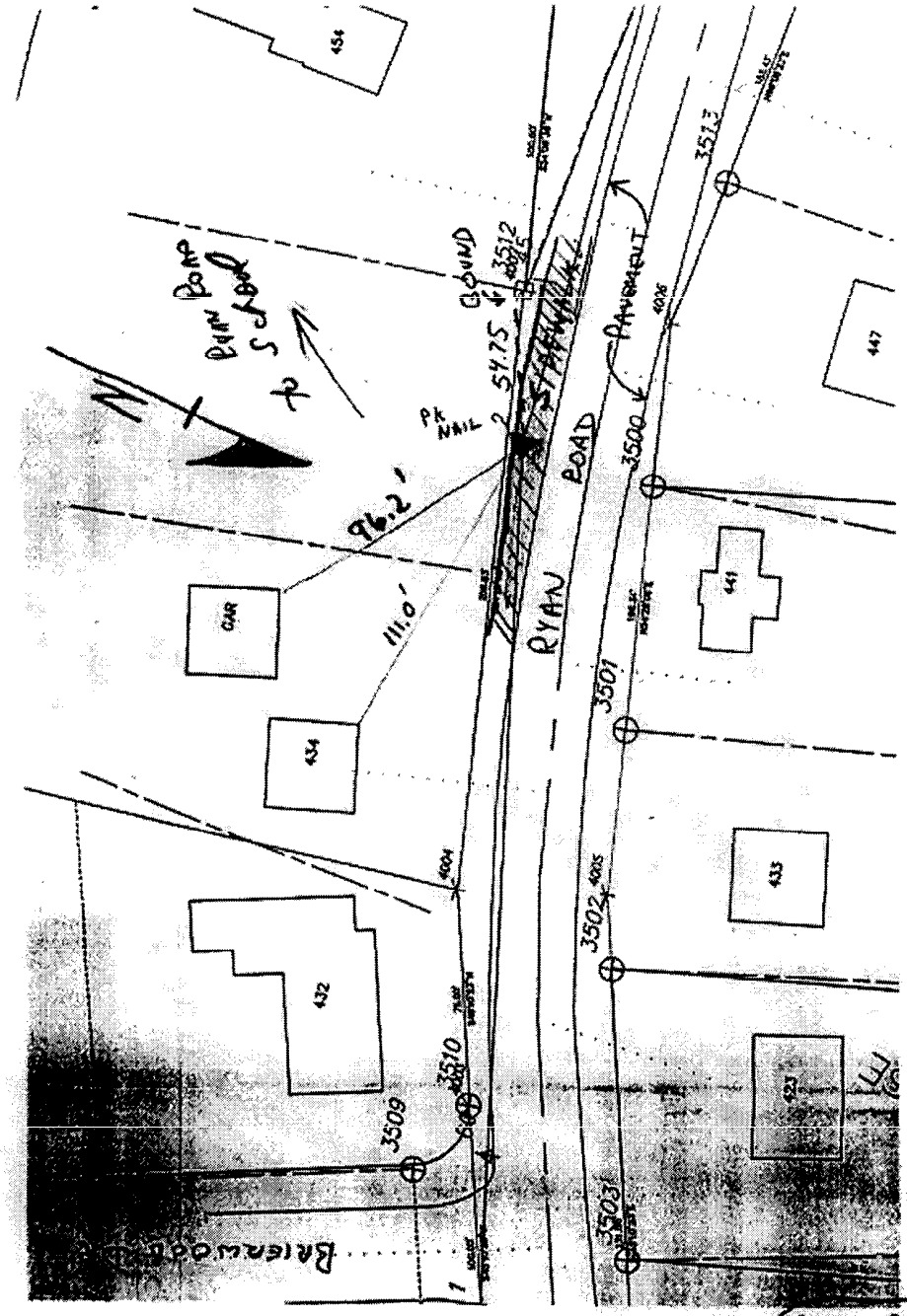
ROBERGE ASSOCIATES LAND SURVEYING
21 MOHAWK TRAIL #283
GREENFIELD, MASSACHUSETTS 01301-3252
(413) 772-2801

RA-915

9009



33
RYAN
N
POLE #99/96
52'
Rebar in grass, opposite store
10'±
31
109.36
46" OAK
±7.43
SYLVESTER
WEST FARMS
ROAD SIGN
POLE #33
±7.04
10.88
32
33.18
STOP SIGN
TURKEY KILL RD
22" W. PINE
STORE
REBAR IN GRASS
RARY31
FIELD △31
GPS △9010



RA-RY2

Pk NAIL IN SIDEWALK
FIRM △2
GPS △9011