CITY OF HOUSTON
HOUSTON AIRPORT SYSTEM

ELLINGTON FIELD

SURVEYORS HANDBOOK

August 2005

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civil engineering • land surveying

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ELLINGTON FIELD SURVEYORS HANDBOOK

City of Houston, Texas
Houston Airport System

FOREWORD

This handbook has been designed to provide information to land surveyors, engineers, and others who use survey control in conjunction with the planning, designing, and constructing of facilities and improvements to the City-owned Ellington Field (EFD) in southeast Houston. The handbook discusses recent control surveys, their basis and relationships to other control systems, and their recommended uses. It includes a network map showing the approximate locations of all airport Primary Control Monuments and individual location sketches with coordinates and elevations for each monument. Any project which requires the use of survey control should refer to this document for recommendations and information regarding this control.

BACKGROUND

Prior to 2003, improvement projects at EFD were tied to existing City of Houston survey control monuments which were established in the 1970's. They were referenced horizontally to the North American Datum of 1927 and vertically to the National Geodetic Vertical Datum of 1929. These two reference datums were replaced in the 1980's by the North American Datum of 1983 and the North American Vertical Datum of 1988. However, improvement projects continued to be referenced to the old system into the 21st century, despite the fact that new technologies and applications which worked in the newer datums, such as GIS and GPS, were revolutionizing navigation, airport planning, and other related fields.

This handbook provides the results of control surveying performed in two parts at EFD in order to create a new network of benchmarks for use on all future improvement projects. Surveying was performed in 2003 within the Airport Operations Area (AOA) to establish control at the six major runway endpoints and in nearby open areas. In 2005 this survey was extended to include three newly installed benchmarks outside of the AOA in support of future improvement projects which are being considered. The network of control points thus created is referred to as the EFD Primary Control Network.

SURVEY OF EFD PRIMARY CONTROL NETWORK

PART 1: THE 2003 RUNWAY ENDPOINT SURVEY

Horizontal and vertical control surveying was first performed by Landtech Consultants, Inc. at Ellington Field from May 5-22, 2003. The purpose of the survey was to establish precise coordinates and elevations for monumentation located generally at the endpoints of the three main runways. These six points are located specifically at the intersection of the centerline of the runway with the outboard edge of the runway threshold bars at both ends of the three main runways.

The initial inspection of the endpoint locations showed that one runway, 4-22, had stable markers (PK Nails) already in place. The other two runways did not and we set 2" brass disks at those four locations.

A search for existing control monumentation, as established and/or published by the National Geodetic Survey (NGS), located on and around the airport was performed. All points used are referenced horizontally to NAD 83(1993) and vertically to NAVD 88. The following is a summary of existing NGS monuments found and tied:

Name	Hor. Order	Vert. Order	Mon. Type	Stability	On/Off Airport
ANG 1 30	First	None(GPS)	Brass Disk in Conc.	C	On
EFD D	B	None(GPS)	Metal Rod in Sleeve	A	On
EFD A	Second	None(GPS)	Brass Disk in Conc.	C	On
EFD B 1985	First	None(GPS)	Brass Disk in Conc.	C	On
EFD C	Second	None(GPS)	Alum. Disk in Conc.	D	On
HGCSD 48	First	None(GPS)	Metal Rod in Sleeve	A	Off
HGCSD 49	First	None(GPS)	Metal Rod in Sleeve	A	Off
HGCSD 51	First	None(GPS)	Metal Rod in Sleeve	A	Off

One GPS Continuously Operating Reference Station (CORS), known as "LAKE HOUSTON CORS ARP" or "LKHU", was also tied in to the project. The positional data for CORS Epoch Data 1997.00 was used for this point.

At the time of the 2003 runway endpoint survey the Harris County Flood Control District was in the process of revising the FEMA Flood Insurance Rate Maps and establishing a new network of Reference Marks as a part of the Tropical Storm Alison Recovery Project (TSARP). Those marks are considered to be of good stability and were surveyed using GPS. The final coordinates and elevations had not been published as of the completion date of the runway endpoint survey. Preliminary values were made available and our survey corresponded very closely to them.

GPS Static surveys were conducted to observe the network of baselines connecting the NGS and TSARP points to the Runway Endpoint Monuments. In the final network adjustment, the published positions for three horizontal points and three vertical points were held, and the rest of the network was adjusted to a best fit around those points. The final adjustment meets relative positioning accuracy standards for NGS Second Order Class I GPS surveys. The points held were as follows:

Name	Held for Horiz.	Held for GPS Vertical
ANG 1 30		√
HGCSD 48	√	√
HGCSD 49	√	
HGCSD 51		√
LKHU	√	

One vertical point that was held, "ANG 1 30", is located on the airport site. Final coordinates and preliminary elevations of all points were established based on this adjustment of the GPS survey. Final elevations were determined by holding the published elevation at "ANG 1 30" and the GPS preliminary elevations at three other points – EFD D, EFD A, and RW22. Precise differential leveling was performed to tie all points together with closed level loops and a network least square adjustment was performed. All loop closures met NGS Second Order Class II closure requirements.

PART 2: THE 2005 LANDSIDE CONTROL EXTENSION

Landtech performed additional horizontal and vertical control surveying in April, 2005 which tied the control that was surveyed in 2003 to three newly established benchmarks outside of the AOA ("landside"). The landside points were established so as to have good stability and survivability over time and were placed so as to be intervisible. Static GPS procedures were used to tie the 2003 points to the landside points horizontally, and digital leveling was used to tie them vertically. All surveys met or exceeded the original survey standards.

NAMING OF MONUMENTS AND RECOVERY SKETCH FORMAT

The numeric system of naming the monuments is the standard system currently in use by the City of Houston. City Surveyor Robert Towery, RPLS, was consulted in this regard and provided the method of naming as well as the standard City of Houston monument recovery sketch template which was used on the recovery sketches included herein. The first four digits of the monument name refer to the City's map sheet number

which the monument plots on. The second group of four digits refers to the position on the sheet which the monument plots on, based on a 16 x 16 interior grid. For further information refer to the City of Houston Department of Public Works publication *Comprehensive Survey Monumentation and Mapping Program User's Manual*. Per Mr. Towery's instructions, currently all new monuments are using a revised numbering structure wherein the numbering of the east-west interior grid has been modified from the original, which ranged from 1 to 16, to a new range of 71 to 86.

USE OF SURVEY DATA

Horizontal and vertical positions for all PCN monuments are provided in tables and recovery sheets. Positions are stated in several different systems for different uses. For horizontal positions, the geodetic NAD83 (1993 adj.) positions are provided (Latitudes and Longitudes). Grid coordinates, expressed as Y and X values and referenced to the Texas Coordinate System of 1983, South Central Zone, are also provided and are correlated to the geodetic positions. The grid coordinates have also been scaled up to surface coordinate values using a project scale factor of 0.9998771847 and the formulae:

$$Y_{Grid} \,/\, 0.9998771847 = Y_{Surface}; \quad X_{Grid} \,/\, 0.9998771847 = X_{Surface}$$

It is recommended that, for all new design and construction related uses, surveys and maps should be prepared using the surface coordinates as provided. This will result in a uniform scaling of coordinates for all projects and make possible an easy integration of separate project surveys and maps into a single system such as a GIS.

For vertical positions, the NAVD88, 2001 adjustment, was used for all benchmark elevations. This was the most recent adjustment available at the time of the 2003 survey and was also used for the above referenced TSARP program. Because EFD is located in an area where little or no ground subsidence has been experienced in recent years (according to the Harris Galveston Coastal Subsidence District), the 2001 adjustment should also be compatible with the new City of Houston CORS stations that came on line in 2004 for use on City Public Works projects.

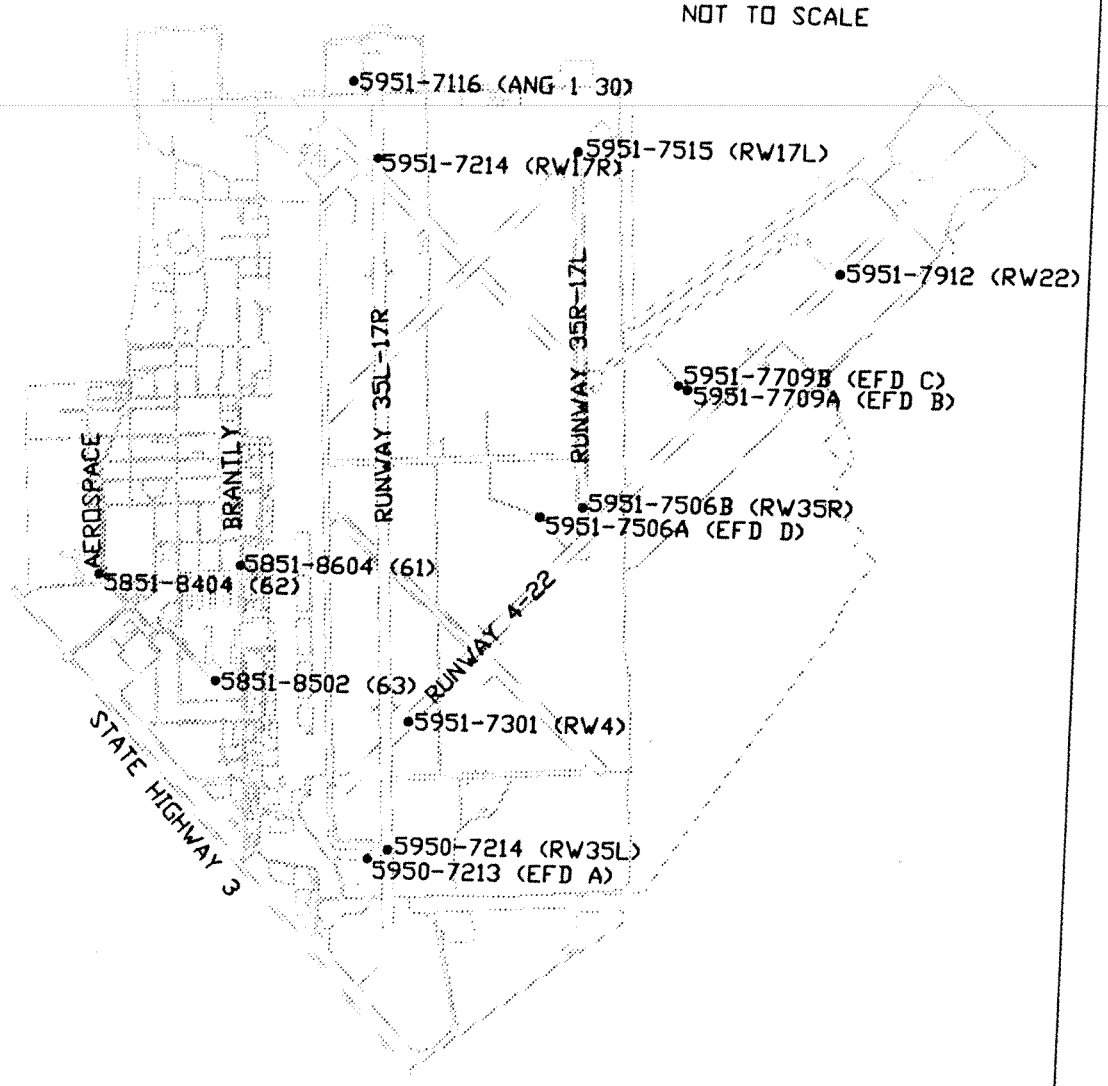
DATUM STATEMENT

The following datum statement is a summary of the above discussion and will apply to the use of all survey data provided herein:

All coordinates are referenced to NAD 83(1993). Horizontal control surveys were performed using GPS. The published coordinates for NGS Stations "HGCSD 48", "HGCSD 49", and CORS Station "LAKE HOUSTON CORS ARP" (Epoch Date 1997.00) were held as fixed in the final network adjustment. All elevations are referenced to NAVD88. Vertical control surveys were performed using GPS and differential leveling. The published elevations for NGS Stations "HGCSD 48", "HGCSD 51", and "ANG 1 30" were held as fixed in the final network adjustment. Geoid heights were determined using GEOID99. The unit of measure for this project is the U. S. Survey Foot.

FINAL COORDINATES AND ELEVATIONS
PRIMARY CONTROL NETWORK

POINT NAME	NAD 83(1993) GRID		NAD 83(1993) SURFACE		NAD 83(1993) GEOGRAPHIC		NAVD 88	ALSO KNOWN AS
	Northing (Y)	Easting (X)	Northing (Y)	Easting (X)	Latitude	Longitude	Elevation	
5951-7116	13793326.921	3186576.064	13795021.161	3186967.472	29 37 15.79224 N	95 09 55.47156 W	30.840	ANG 1 30
5951-7506A	13787742.103	3189219.524	13789435.657	3189611.257	29 36 19.67126 N	95 09 27.61331 W	29.482	EFD D
5950-7213	13783236.472	3187146.726	13784929.472	3187538.204	29 35 35.76110 N	95 09 52.75776 W	26.453	EFD A
5951-7709A	13789441.040	3191083.250	13791134.802	3191475.212	29 36 35.87577 N	95 09 05.87679 W	29.277	EFD B
5951-7709B	13789494.501	3190963.129	13791188.270	3191355.076	29 36 36.44391 N	95 09 07.21706 W	29.045	EFD C
5951-7515	13792483.439	3189527.866	13794177.575	3189919.637	29 37 06.48676 N	95 09 22.35675 W	31.197	RW17L
5951-7214	13792347.940	3186930.929	13794042.059	3187322.381	29 37 05.99000 N	95 09 51.81649 W	31.914	RW17R
5951-7912	13790985.213	3192966.803	13792679.165	3193358.996	29 36 50.54144 N	95 08 43.97160 W	30.230	RW22
5950-7214	13783361.498	3187407.903	13785054.514	3187799.414	29 35 36.91343 N	95 09 49.75427 W	27.512	RW35L
5951-7506B	13787881.522	3189772.413	13789575.093	3190164.214	29 36 20.87099 N	95 09 21.30093 W	30.032	RW35R
5951-7301	13785037.233	3187617.394	13786730.454	3188008.930	29 35 53.42701 N	95 09 46.75978 W	26.029	RW4
5851-8604	13787018.730	3185337.233	13788712.195	3185728.489	29 36 13.77394 N	95 10 11.84171 W	28.304	61
5851-8404	13786864.490	3183504.168	13788557.936	3183895.199	29 36 12.84149 N	95 10 32.65475 W	33.750	62
5851-8502	13785507.440	3185072.773	13787200.719	3185463.997	29 35 58.90532 N	95 10 15.39668 W	28.596	63
HGCSD 48	13794220.345	3169029.079	13795914.694	3169418.332	29 37 30.28684 N	95 13 13.86608 W	40.490	(OFFSITE)
HGCSD 49	13798560.336	3203638.452	13800255.218	3204031.956	29 38 01.99992 N	95 06 40.27256 W	15.550	(OFFSITE)
HGCSD 51	13773128.018	3201995.063	13774819.777	3202388.365	29 33 50.88822 N	95 07 08.44838 W	18.860	(OFFSITE)



OVERALL LAYOUT

HORIZONTAL & VERTICAL
CONTROL MONUMENTS
FOR
ELLINGTON FIELD

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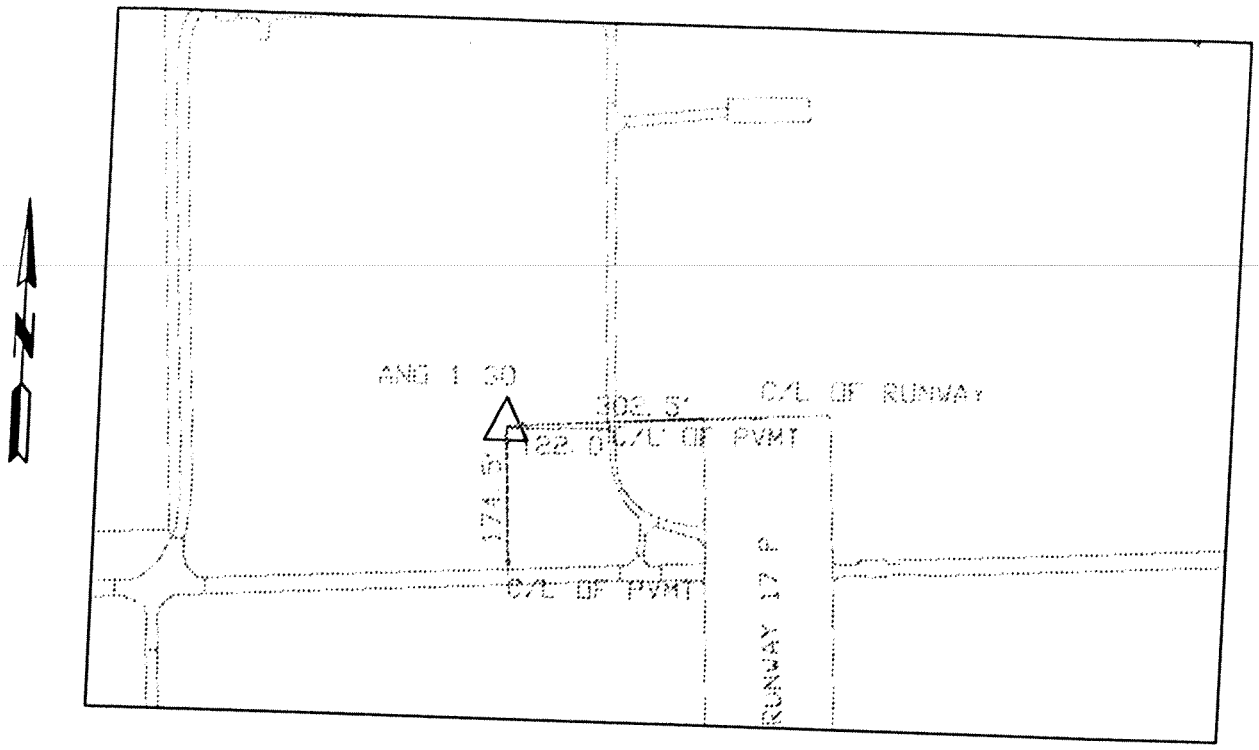
CITY OF HOUSTON

CITY SURVEY MARKER 5951 7116



ON MAP SHEET: 5951 A1

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3186576.064

Y= 13793326.921

Elevations: 30.840' Adjustment: NAVD 88

Method For Vert. Conventional

Lat.= 29°37'15.79224" N

Lon.= 95°9'55.47156" W

Ellipsoid Height= -57.913'

Also Known As: "ANG 1 30"

Method For Horizontal GPS

General Location: Ellington Fld., NW Side Of Airport, West Of Runway End 17R

Date Set: 1989 Type of Mark: NGS - Brass Disk In Concrete

Survey Markers Useful As Azimuth From Station

5951-2214	S 19°55'29" E	1041.31'	<GRID>
5951-7515	S 74°03'09" E	2069.95'	<GRID>

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13795021.161
E = 3186967.472

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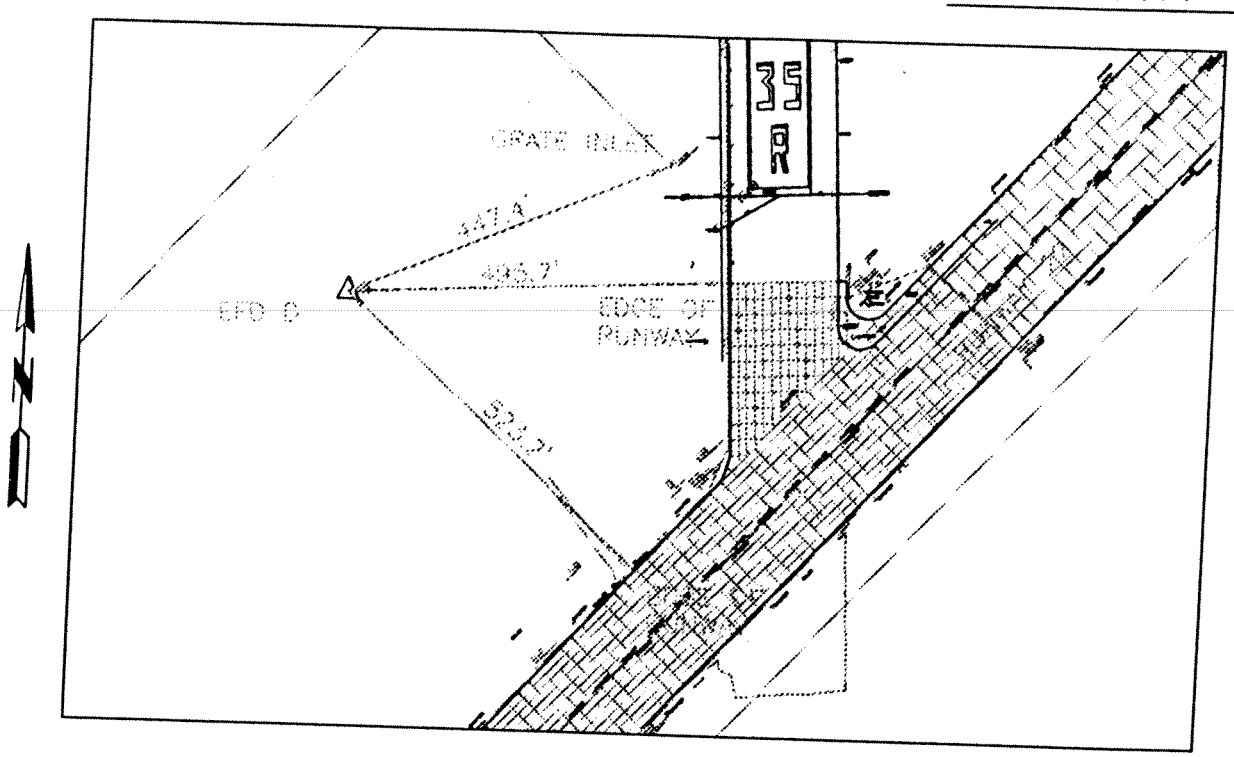
Houston, TX 77008

CITY OF HOUSTON

CITY SURVEY MARKER 5951 7506A



Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3189219.324

Y= 13787742.103

Lat.= 29°36'19.67126" N

Lon.= 95°04'27.61331" W

Method For Horizontal GPS

ON MAP SHEET: 5951 C2

Elevations	Adjustment
29.482'	NAVD 88

Method For Vert. Conventional

Ellipsoid Height= -59.220'

Also Known As: "EFD D"

General Location: Ellington Fld., Midfield Area, North Of TACAN/VOR Bldg.

Date Set: 1994 Type of Mark: NGS - Metal Rod In Sleeve

Survey Markers Useful As Azimuth From Station

5951-7301	S 20°38'20" W	3143.75'	<GRID>
5951-7506B	N 75°50'50" E	570.20'	<GRID>

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13789435.657
E = 3189611.257

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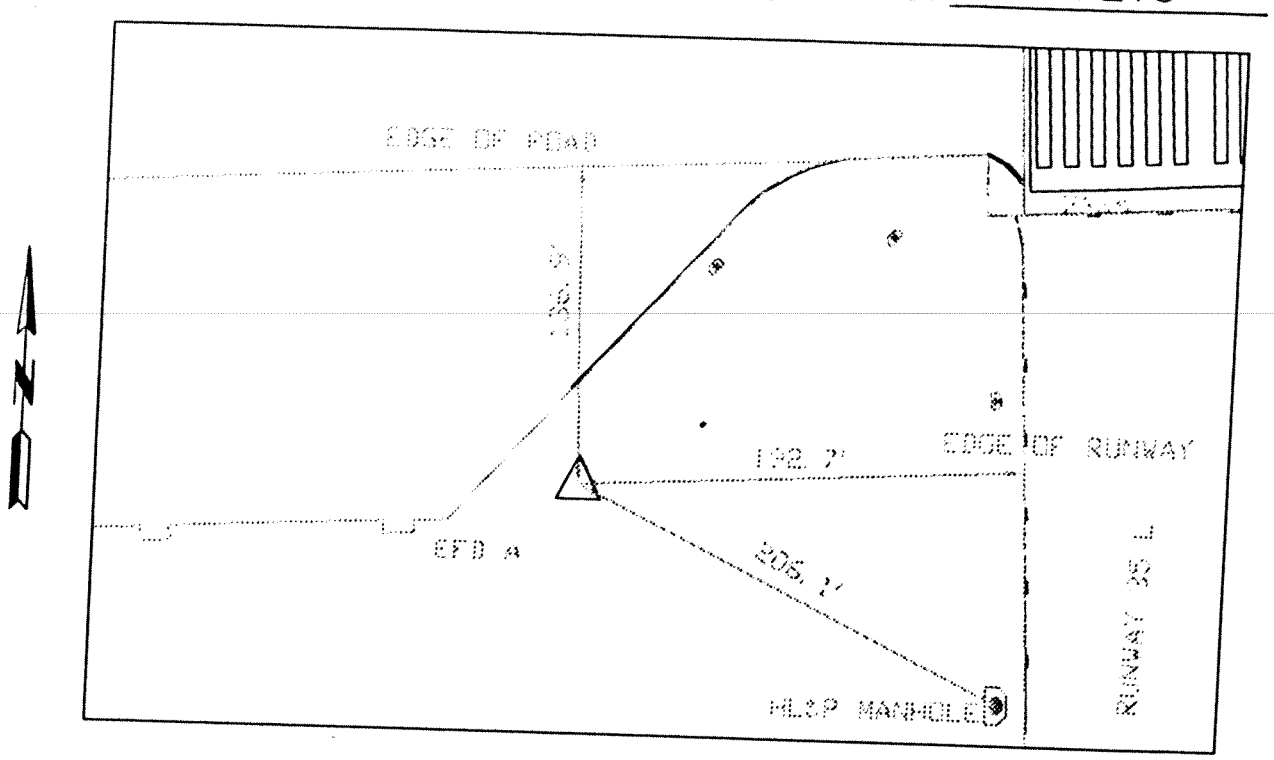
City of Houston, Harris County, Texas

CITY OF HOUSTON

CITY SURVEY MARKER 5950 7213



ON MAP SHEET: 5950 A1

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3187146.726

Y= 13783236.472

Elevations 26.452'

Adjustment NAVD 88

Method For Vert. Conventional

Lat.= 29° 55' 35.76110" N

Lon.= 95° 09' 32.75776" W

Ellipsoid Height= -62.218'

Method For Horizontal GPS

Also Known As: 'EFD A'

General Location: Ellington Fld. SW Side Of Airport. SW Of Runway End 35L

Date Set: 1995 Type of Mark: NGS - Brass Disk In Concrete

Survey Markers Useful As Azimuth From Station

5950-7214 N 64° 25' 10" E 289.56' (GPID)

5951-7301 N 14° 36' 52" E 1861.25' (GPID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13784929.472
E = 3187538.204

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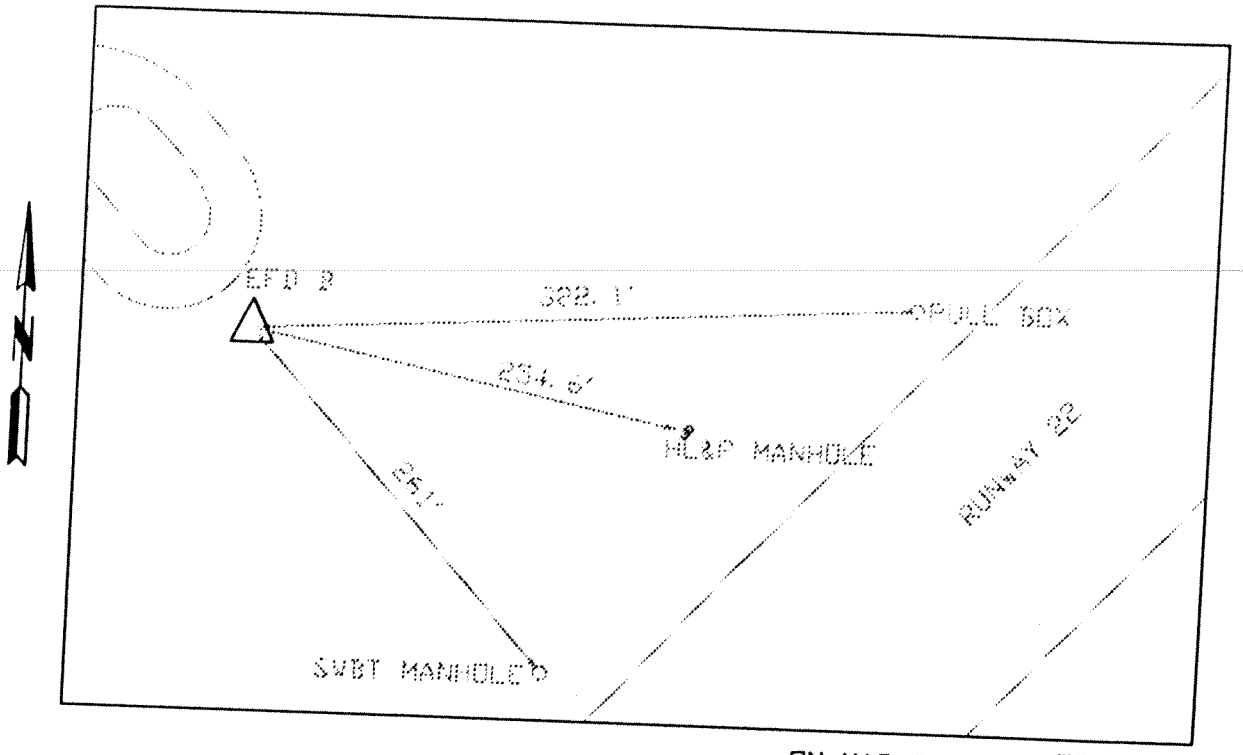
City of Houston, Harris County, Texas

CITY OF HOUSTON

CITY SURVEY MARKER 5951 7709A



ON MAP SHEET: 5951 A4

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3191083.250

Y= 13769441.040

Elevations 29.277' Adjustment NAVD 88

Method For Vert. Conventional

Lat.= 29° 36' 35.87577" N

Lon.= 95° 09' 05.87679" W

Ellipsoid Height= -59.434'

Method For Horizontal GPS

Also Known As: "EFD 2"

General Location: Ellington Fld., In The Grass Area Between Runway 4/22 And Taxiway C

Date Set: 1985 Type of Mark: NGS - Brass Disk In Concrete

Survey Markers Useful As Azimuth From Station

5951-7506B S 40° 02' 54" W 2037.25' (GRID)

5951-7709B N 66° 00' 2" W 131.49' (GRID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13791134.802
E = 3191475.212

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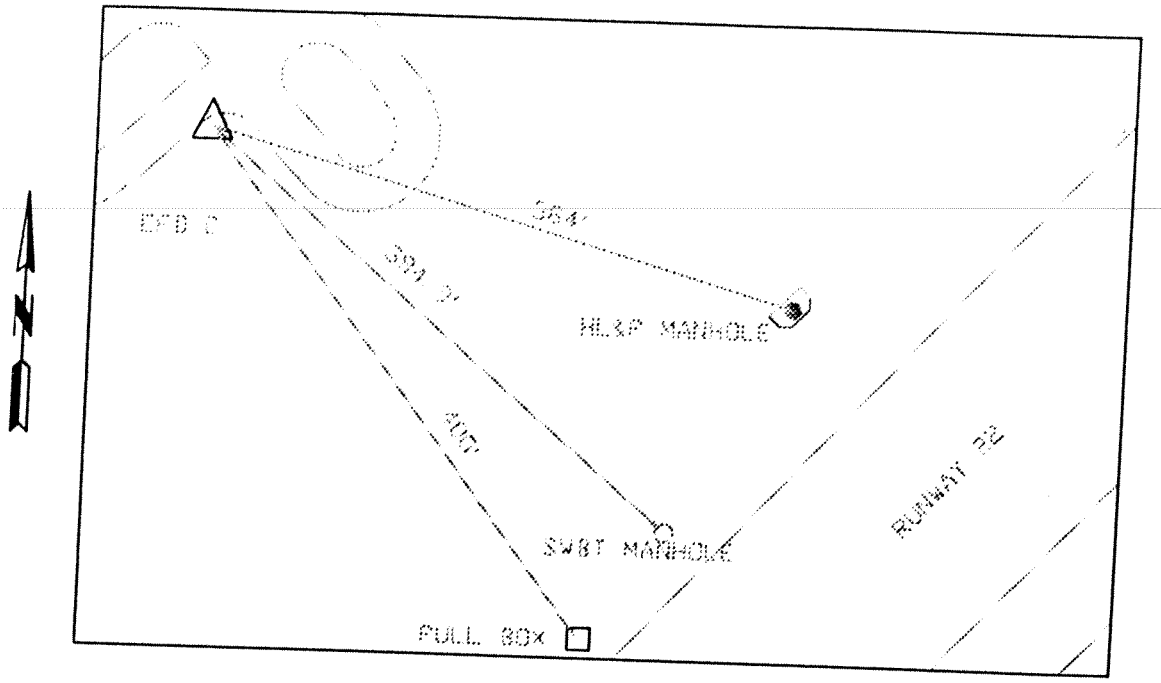
CITY OF HOUSTON

CITY SURVEY MARKER 5951 7709B



ON MAP SHEET: 5951 A4

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3190963.129

Y= 13759494.501

Lat.= 29°36'36.44591" N

Lon.= 95°09'07.21706" W

Method For Horizontal GPS

Elevations 29.045' Adjustment NAVD 88

Method For Vert. Conventional

Ellipsoid Height= -59.695'

Also Known As: "EFD C"

General Location: Ellington Fld., In The Grass Area Between Taxiway "C" And Runway 4-22

Date Set: 1992 Type of Mark: NGS - Aluminum Disk in Concrete

Survey Markers Useful As Azimuth From Station

5951-7709A S 66°00'09" E 131.45' (GRID)

5951-7912 N 53°21'04" E 2497.38' (GRID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13791188.270
E = 3191355.076

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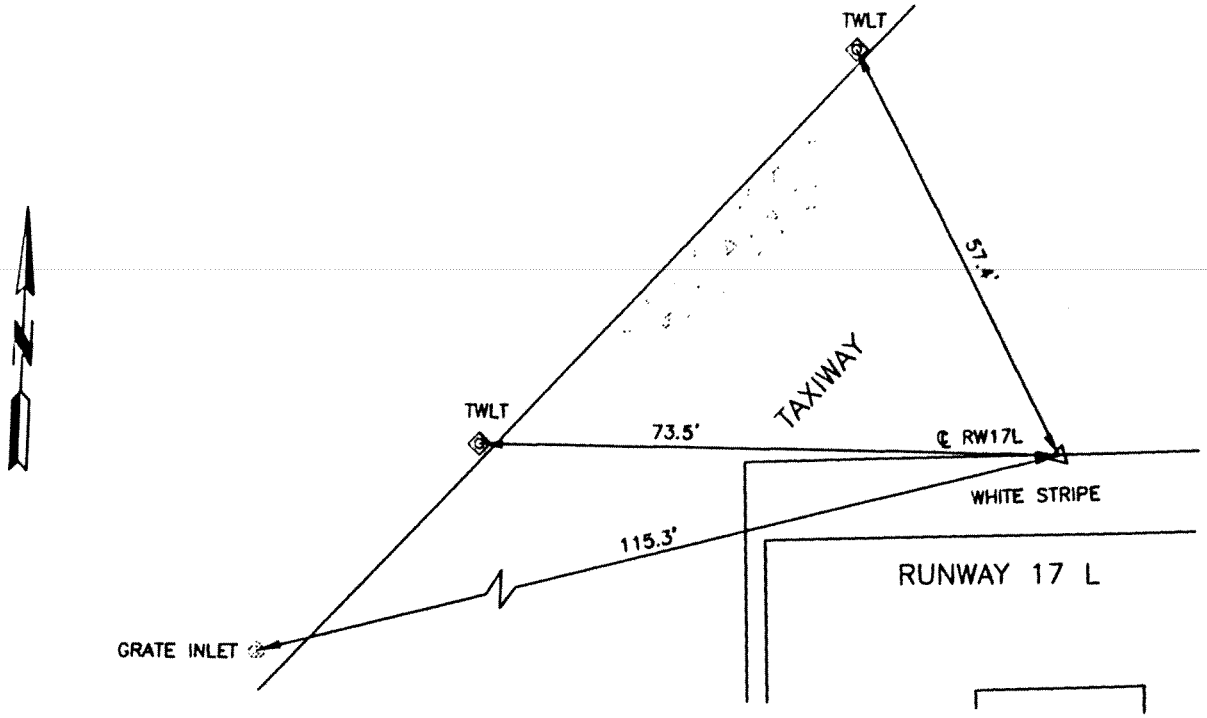
Houston, TX 77008

City of Houston, Harris County, Texas

CITY OF HOUSTON

CITY SURVEY MARKER 5951 7515



ON MAP SHEET: 5951 A2

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3189527.866

Y= 13792483.439

Elevations 31.197' Adjustment NAVD 88

Method For Vert. Conventional

Lat.= 29°37'06.48676" N

Lon.= 95°09'22.35675" W

Ellipsoid Height= -57.568'

Also Known As: "RW17L"

Method For Horizontal GPS

General Location: Ellington Fld., at the threshold bar on the North end of Runway 17L

Date Set: September 2003 Type of Mark: NGS - Aluminum Disk In Concrete

Survey Markers Useful As Azimuth From Station

5951-7116	N 74°03'09" W	3069.95'	(GRID)
5951-7214	S 87°00'48" W	2600.47'	(GRID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13794177.575
E = 3189919.637

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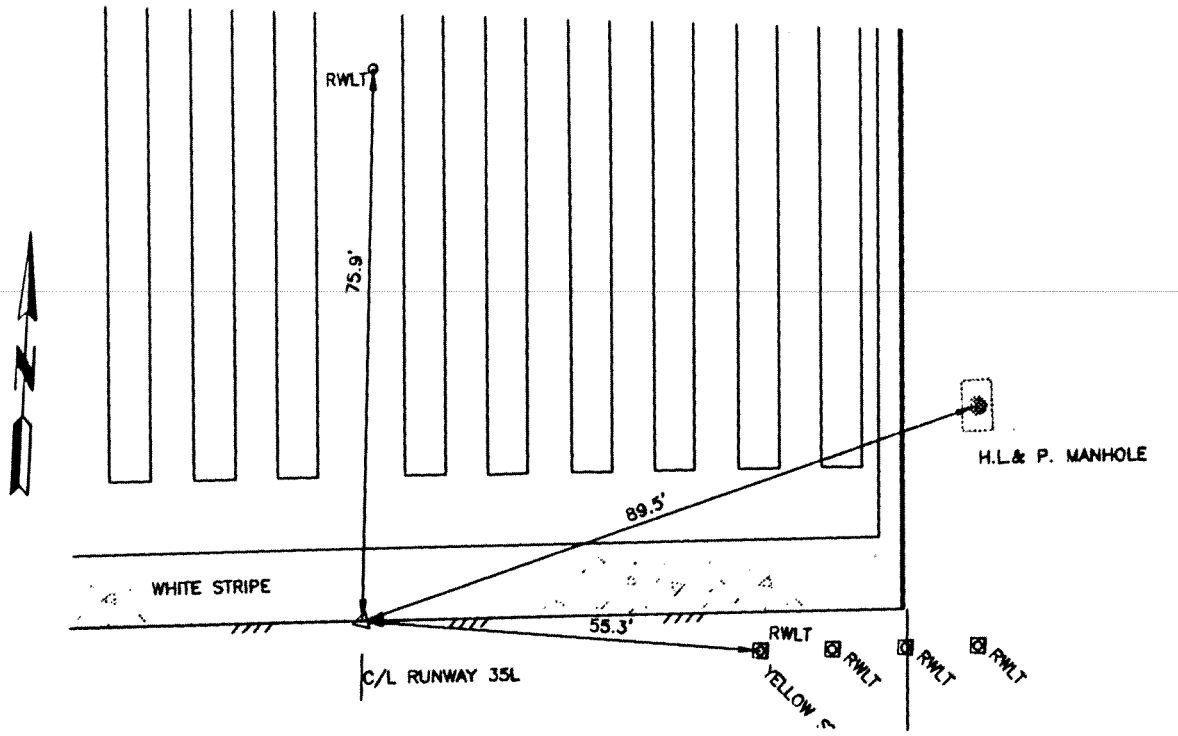
CITY OF HOUSTON

CITY SURVEY MARKER 5950 7214



ON MAP SHEET: 5950 A1

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3187407.903

Y= 13783361.498

Elevations 27.512' Adjustment NAVD 88

Method For Vert. Conventional

Lat.= 29°35'36.91343" N

Lon.= 95°09'49.75427" W

Ellipsoid Height= -61.156'

Also Known As: "RW35L"

Method For Horizontal GPS

General Location: Ellington Fld., Runway Threshold At The Centerline Of Runway 35L

Date Set: September 2003 Type of Mark: 2" Brass Disk

Survey Markers Useful As Azimuth From Station

5950-7213	S 64°25'10" W	289.56'	(GRID)
5951-7301	N 07°07'33" E	1688.78'	(GRID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13785054.514
E = 3187799.414

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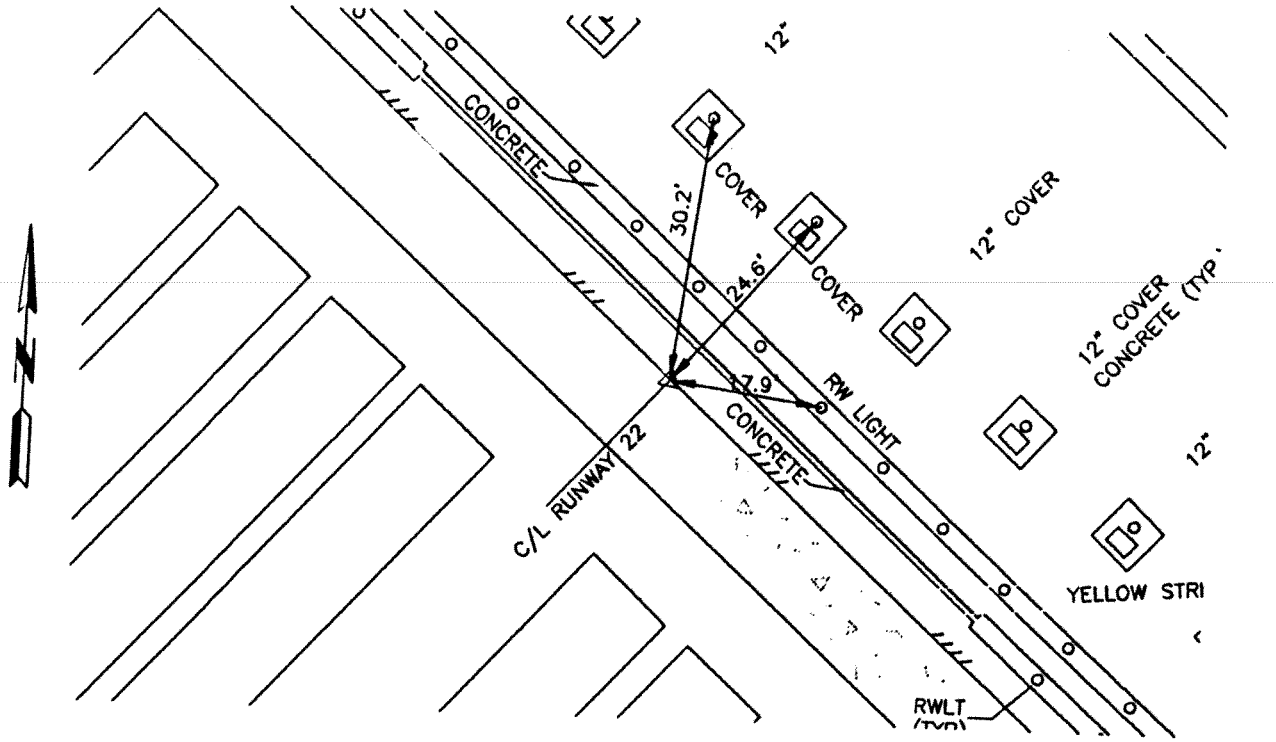
City of Houston, Harris County, Texas

CITY OF HOUSTON

CITY SURVEY MARKER 5951 7912



ON MAP SHEET: 5951 B3

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3192966.803

Y= 13790985.213

Elevations: 30.230' Adjustment: NAVD 88

Method For Vert. Conventional

Lat.= 29° 36' 50.54144" N

Lon.= 95° 08' 43.97160" W

Ellipsoid Height= -58.486'

Method For Horizontal GPS

Also Known As: "RW22"

General Location: Ellington Fld., Runway Threshold At The Centerline Of Runway 22

Date Set: September 2003 Type of Mark: PK NAIL

Survey Markers Useful As Azimuth From Station

5951-7709A	S 50° 39' 16" W	2435.62'	(GRID)
5951-7709B	S 53° 21' 04" W	2497.38'	(GRID)

NOTE:
1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13792679.165
E = 3193358.996

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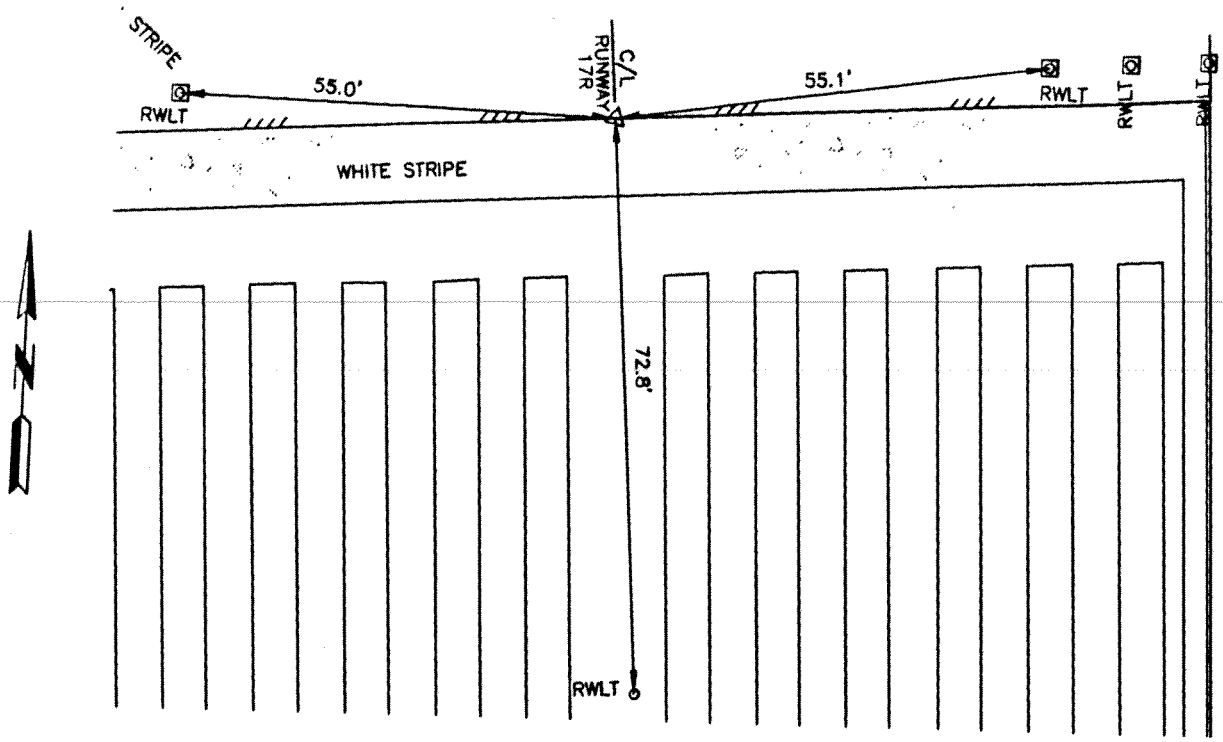
CITY OF HOUSTON

CITY SURVEY MARKER 5951 7214



ON MAP SHEET: 5951 A1

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3186930.929

Y= 13792347.940

Elevations 31.914' Adjustment NAVD 88

Method For Vert. Conventional

Lat.= 29° 37' 05.99000" N

Lon.= 95° 09' 51.81649" W

Ellipsoid Height= -56.833'

Also Known As: "RW17R"

Method For Horizontal GPS

General Location: Ellington Fld., Runway Threshold At The Centerline Of Runway 17R

Date Set: September 2003 Type of Mark: 2" Brass Disk

Survey Markers Useful As Azimuth From Station

5951-7116	N 19° 55' 29" W	1041.31'	(GRID)
5951-7515	N 87° 00' 48" E	2600.47'	(GRID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13794042.059
E = 3187322.381

Surveyed By. LANDTECH CONSULTANTS, INC.
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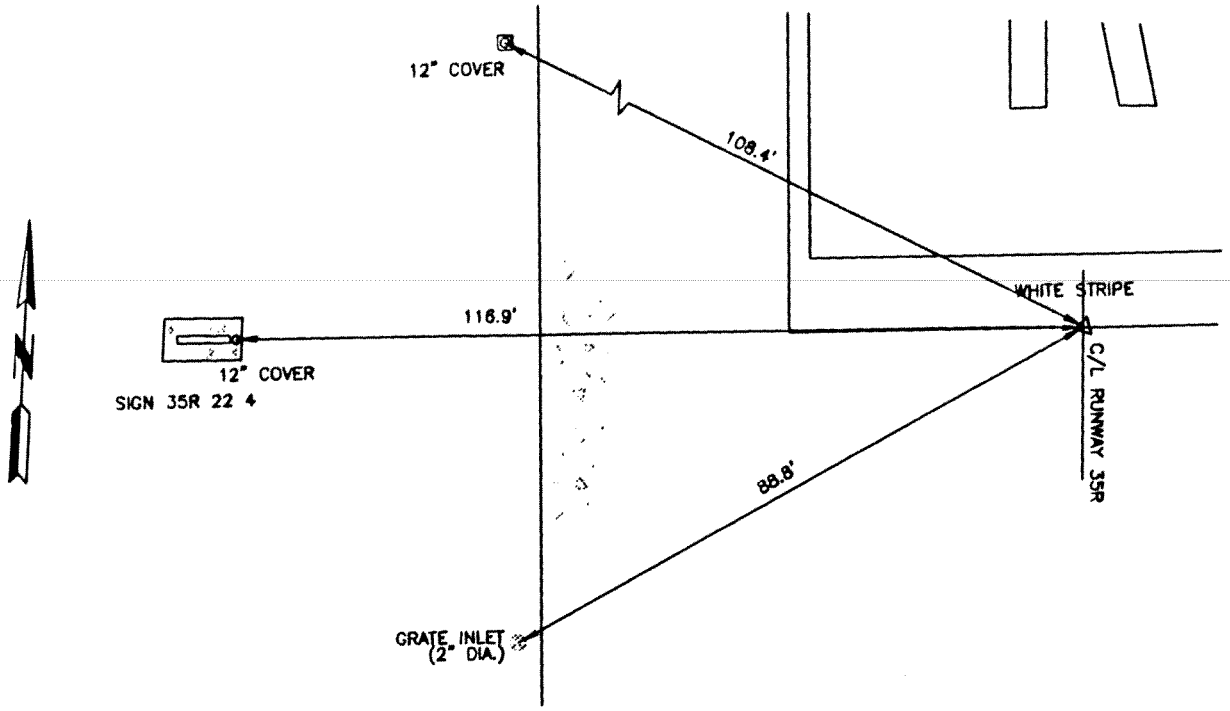
Houston, TX 77008

City of Houston, Harris County, Texas

CITY OF HOUSTON

CITY SURVEY MARKER 5951 7506B



Texas Coordinate System of 1983, S.C. Zone NAD 83
X= 3189772.413
Y= 13787881.522

ON MAP SHEET: 5951 C2

Elevations 30.032' Adjustment NAVD 88

Method For Vert. Conventional

Lat.= 29° 36' 20.87099" N
Lon.= 95° 09' 21.30093" W
Method For Horizontal GPS

Ellipsoid Height= -58.669'

Also Known As: "RW35R"

General Location: Ellington Fld., Runway Threshold At The Centerline Of Runway 35R

Date Set: September 2003 Type of Mark: 2" Brass Disk

Survey Markers Useful As Azimuth From Station

5951-7506A	S 75° 50' 50" W	570.20'	(GRID)
5951-7709A	N 40° 02' 54" E	2037.25'	(GRID)

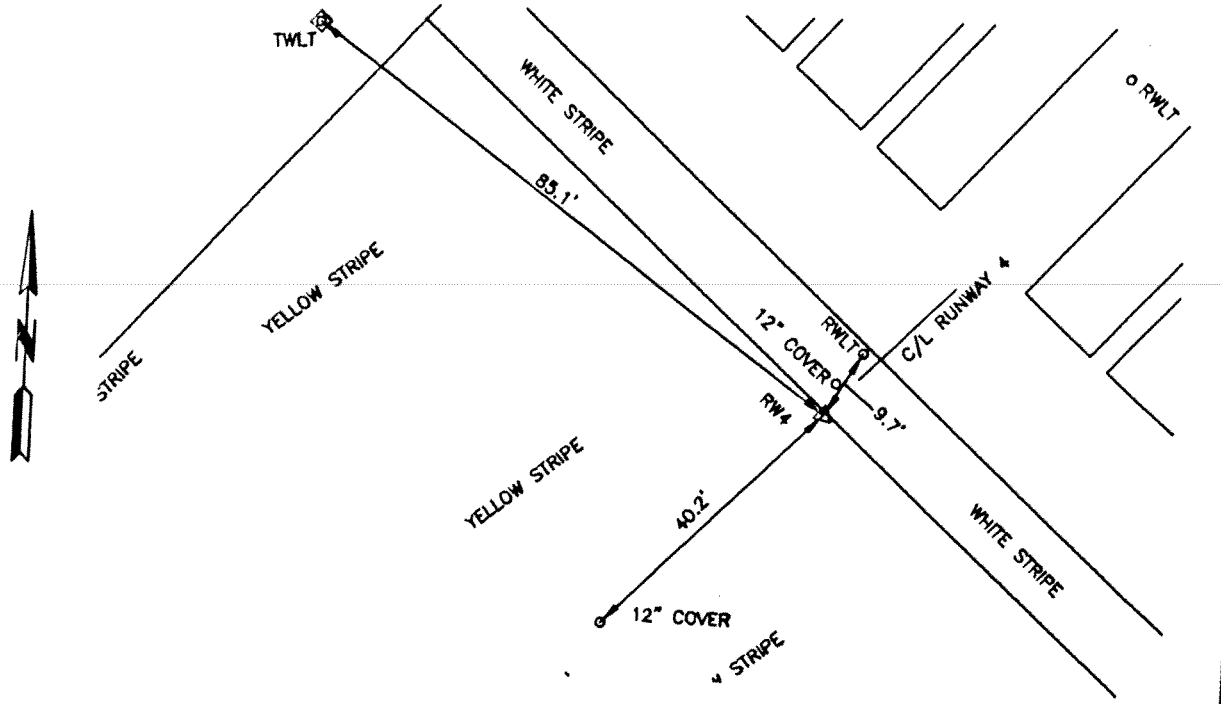
NOTE:
1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13789575.093
E = 3190164.214

Surveyed By. LANDTECH CONSULTANTS, INC.
2627 North Loop West, Ste. 224
Houston, TX 77008

CITY OF HOUSTON

CITY SURVEY MARKER 5951 7301



ON MAP SHEET: 5951 C3

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3187617.394

Y= 13785037.233

Elevations: 26.029' Adjustment: NAVD 88

Method For Vert. Conventional

Lat.= 29° 35' 53.42701" N

Lon.= 95° 09' 46.75978" W

Ellipsoid Height= -62.652'

Method For Horizontal GPS

Also Known As: "RW4"

General Location: Ellington Fld., Runway Threshold At The Centerline Of Runway 4

Date Set: September 2003 Type of Mark: 2" Brass Disk

Survey Markers Useful As Azimuth From Station

5950-7213	S 14° 38' 52" W	1861.25'	(GRID)
5950-7214	S 07° 07' 33" W	1688.78'	(GRID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13786730.454
E = 3188008.930

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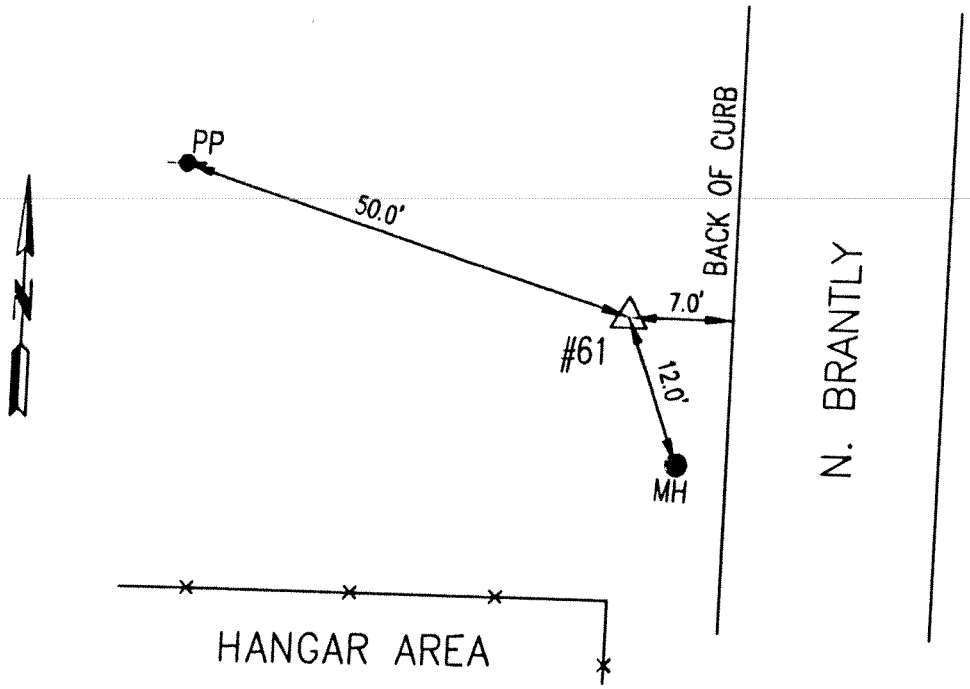
Houston, TX 77008

City of Houston, Harris County, Texas

CITY OF HOUSTON

CITY SURVEY MARKER 5851 8604



ON MAP SHEET: 5851 01

Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3185337.233

Y= 13787018.720

Elevations 28.304' Adjustment NAVD 88

Method For Vert. Conventional

Lat.= 29° 36' 13.77394" N

Lon.= 95° 10' 11.94171" W

Ellipsoid Height= -60.379'

Method For Horizontal GPS

Also Known As: "61"

General Location: Ellington Fld., NE Of Hangers, On West Side of No. Brantly St., Approx. 325 Feet South Of Hutchinson Ct.

Date Set: April 2005 Type of Mark: Aluminum Rod In Sleeve

Survey Markers Useful As Azimuth From Station

5851-9404 S 85° 11' 25" W 1939.54' (GRID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13788712.195
E = 3185728.489

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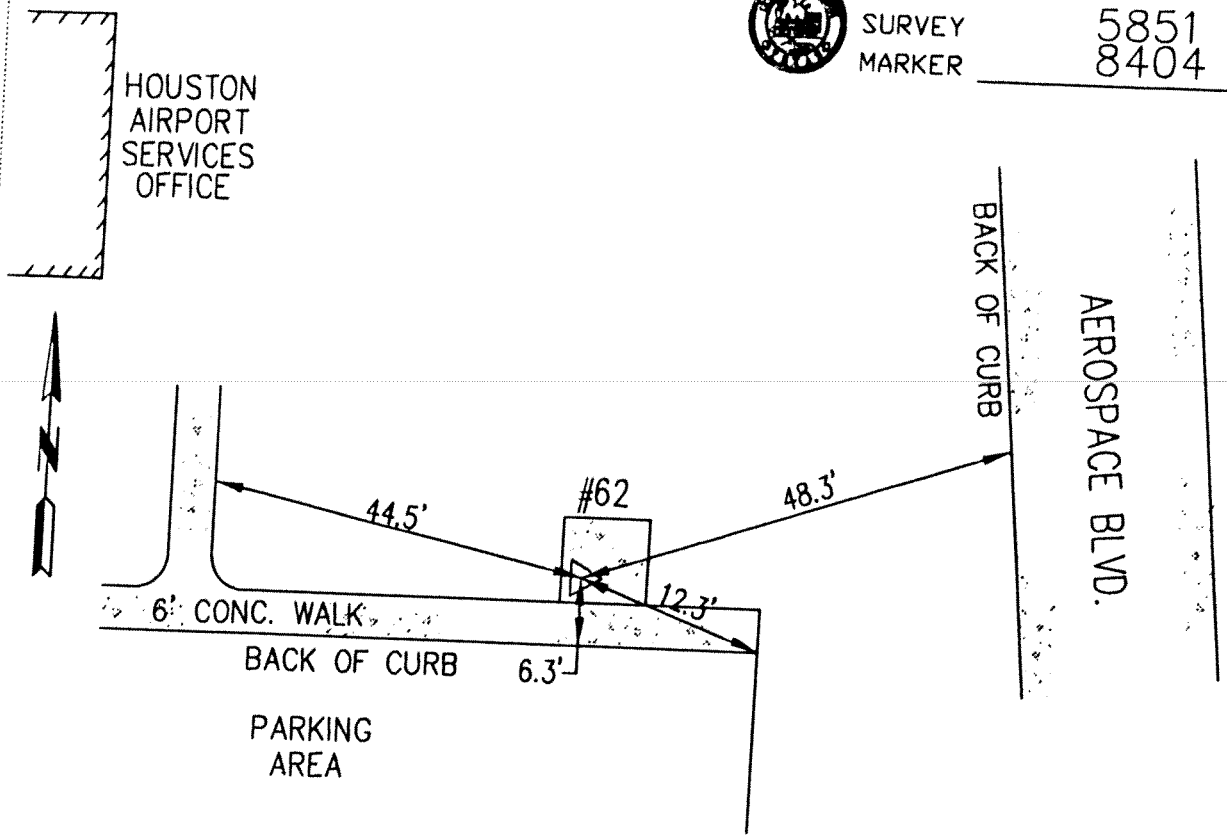
Houston, TX 77008

City of Houston, Harris County, Texas

CITY OF HOUSTON

CITY SURVEY MARKER 5851 8404



Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3183504.169

Y= 13786864.490

Lat.= 29° 36' 12.84149" N

Lon.= 95° 10' 32.65475" W

Method For Horizontal GPS

ON MAP SHEET: 5851 D4

Elevations: 33.750'

Adjustment: NAVD 88

Method For Vert. Conventional

Ellipsoid Height= -54.938'

Also Known As: "62"

General Location: Ellington Fld., Approx. 50 Ft. West Of Aerospace Blvd., On So. Side Of Aviation Bldg., On SW Cor. 3 x 3 Conc. Pad

Date Set: April 2005 Type of Mark: Disk In Concrete

Survey Markers Useful As Azimuth From Station

5851-8404 N 85° 11' 25" E 1839.54' <GRID>

5851-8502 S 49° 08' 09" E 2074.15' <GRID>

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13788557.936
E = 3183895.199

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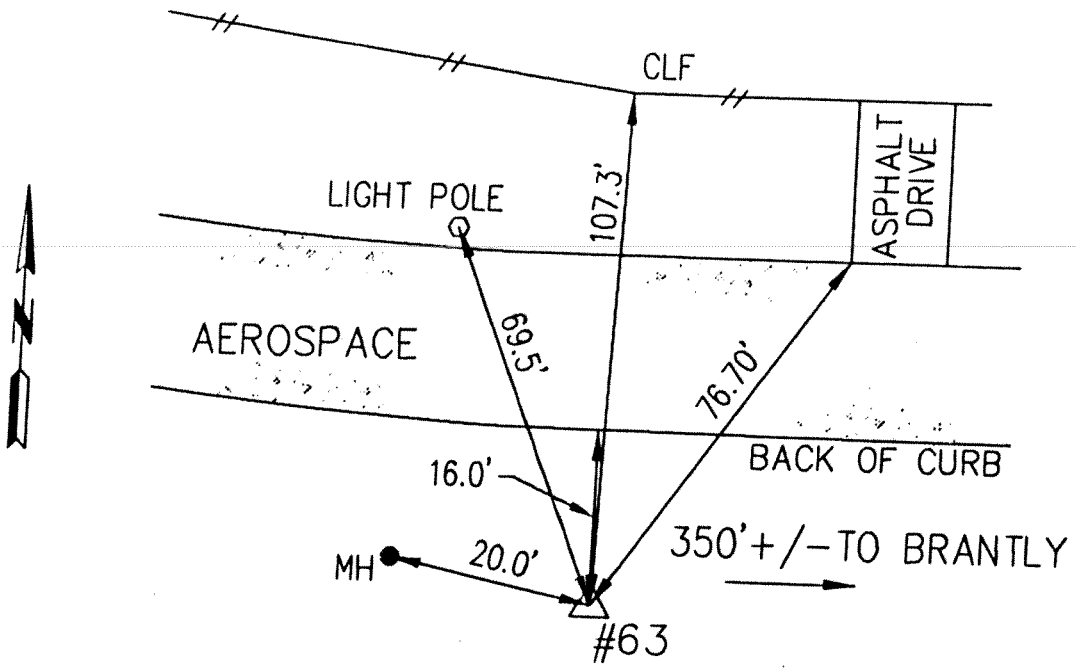
City of Houston, Harris County, Texas

CITY OF HOUSTON

CITY SURVEY MARKER 5851 8502



Texas Coordinate System of 1983, S.C. Zone NAD 83

X= 3185072.773

Y= 13785307.440

Lat.= 29 35 58.90532 N

Lon.= 95 10 15.36662 W

Method For Horizontal GPS

ON MAP SHEET: 5851 D4

Elevations: 28.596' Adjustment: NAVD 88

Method For Vert. Conventional

Ellipsoid Height= -60.052'

Also Known As: "63"

General Location: Ellington Fld., Approx. 350 Ft. West Of Brantly St., Approx. 16 Ft. So. Of The So. Edge Of Aerospace Blvd.

Date Set: April 2005 Type of Mark: Aluminum Pad In Sleeve

Survey Markers Useful As Azimuth From Station

5851-8404 N 49°08'09"W 2074.15' (GPID)

NOTE:

1. Azimuths are from South orientation.
2. Scale Factor (S.F. 0.9998771847).
3. Surface= Grid / S.F.

Airport Surface Coordinates
N = 13787200.719
E = 3185463.997

Surveyed By. LANDTECH CONSULTANTS, INC.
2527 North Loop West, Ste. 224
Houston, TX 77008

City of Houston, Harris County, Texas