Agricultural Lot Boundary Re-establishment by the 1949 Aerial Photograph

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and

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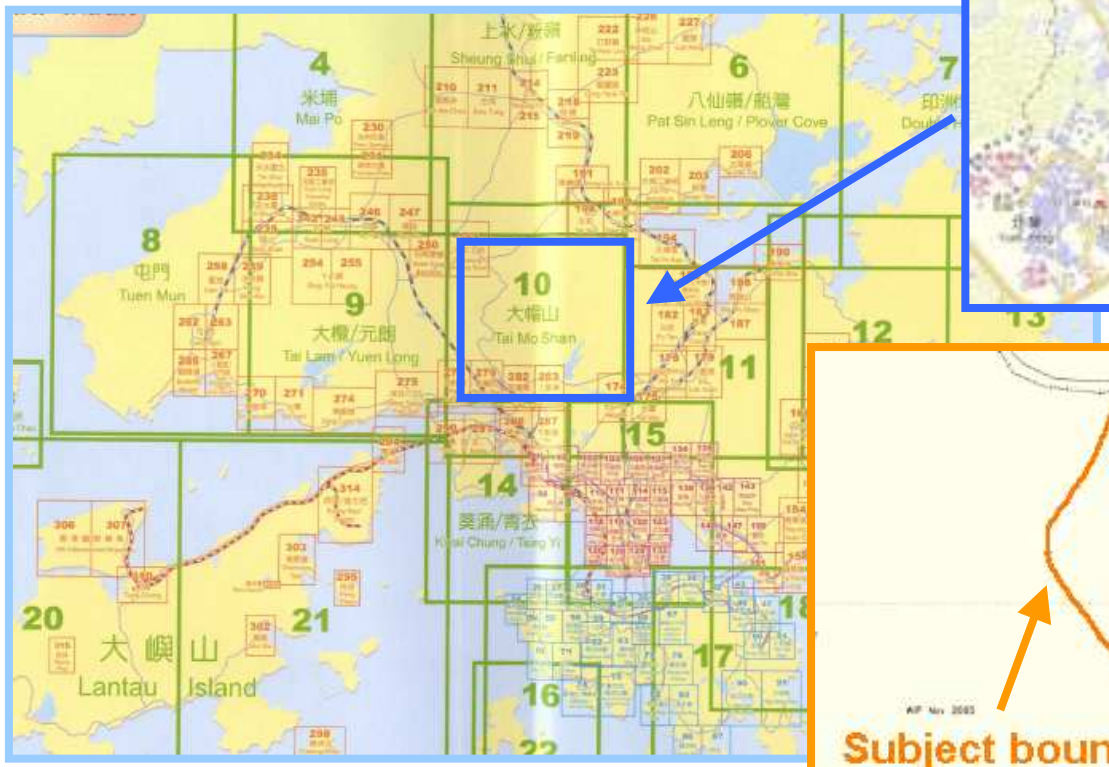
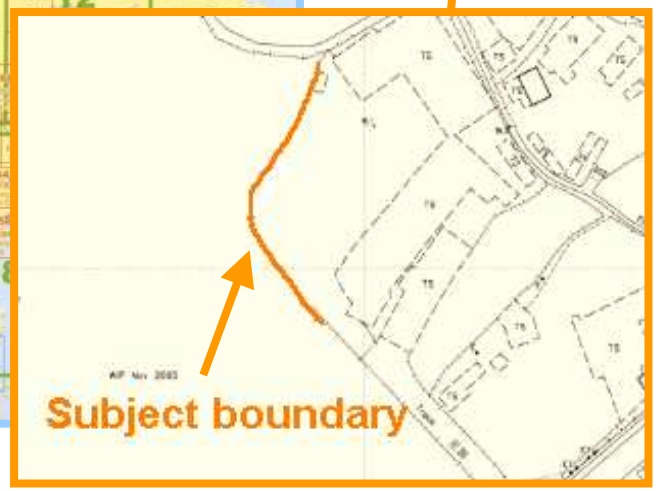
Request from a practicing land surveying firm in December 2007

- Provide the best accurate boundary determination (1m) in the disputed field-bund boundary (3m) between Lot 1169 & 1170RP in DD 106

Subject Lot

Pat Heung



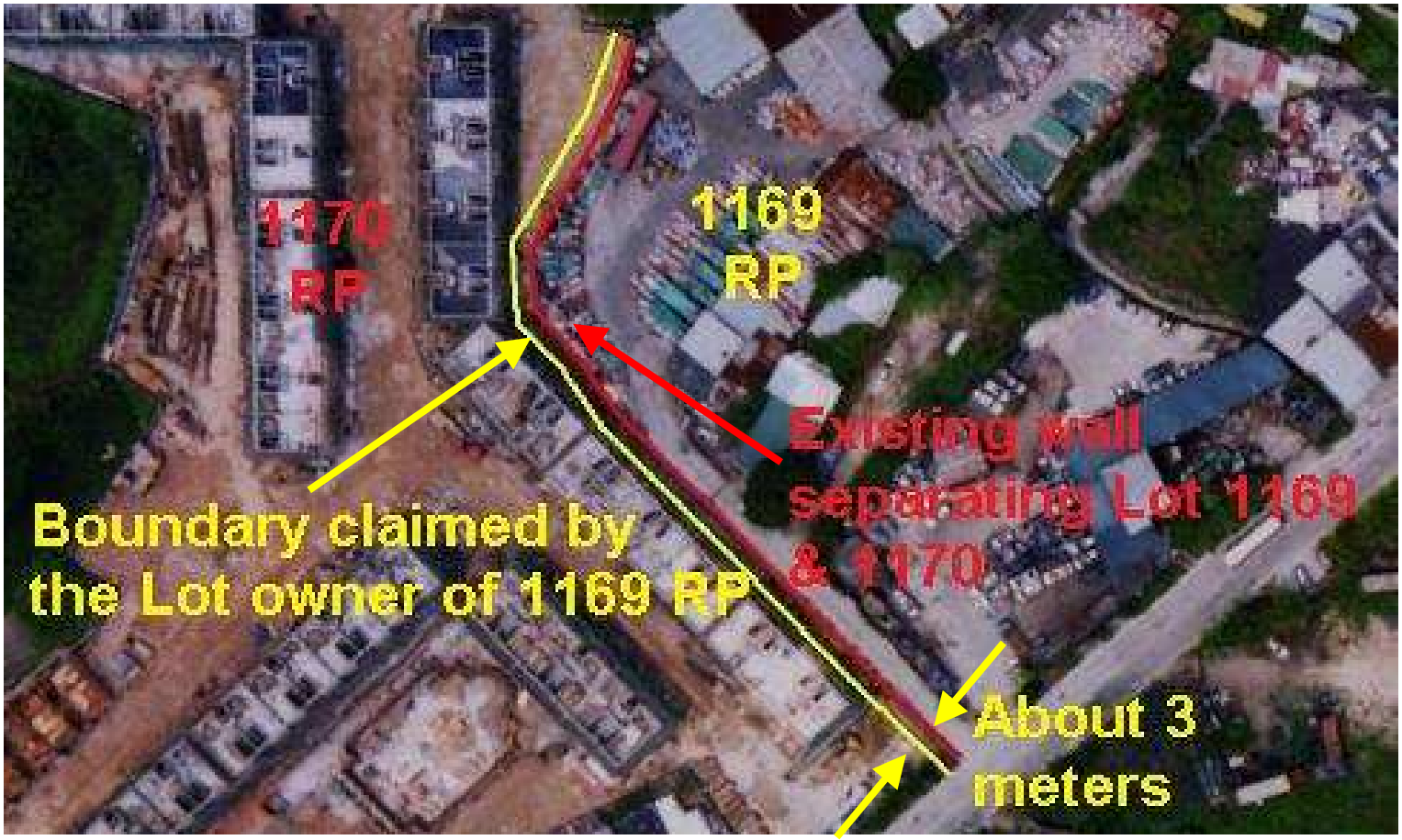


Lot 1169 & 1170

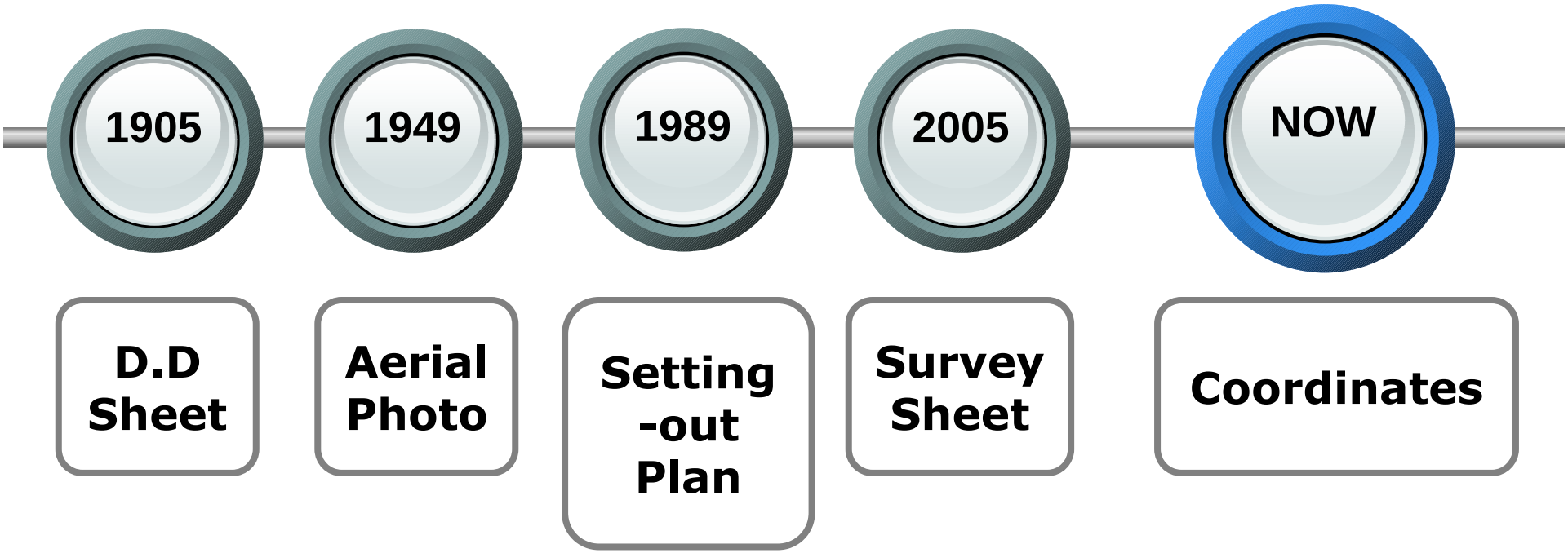
Hong Kong

Dispute overview

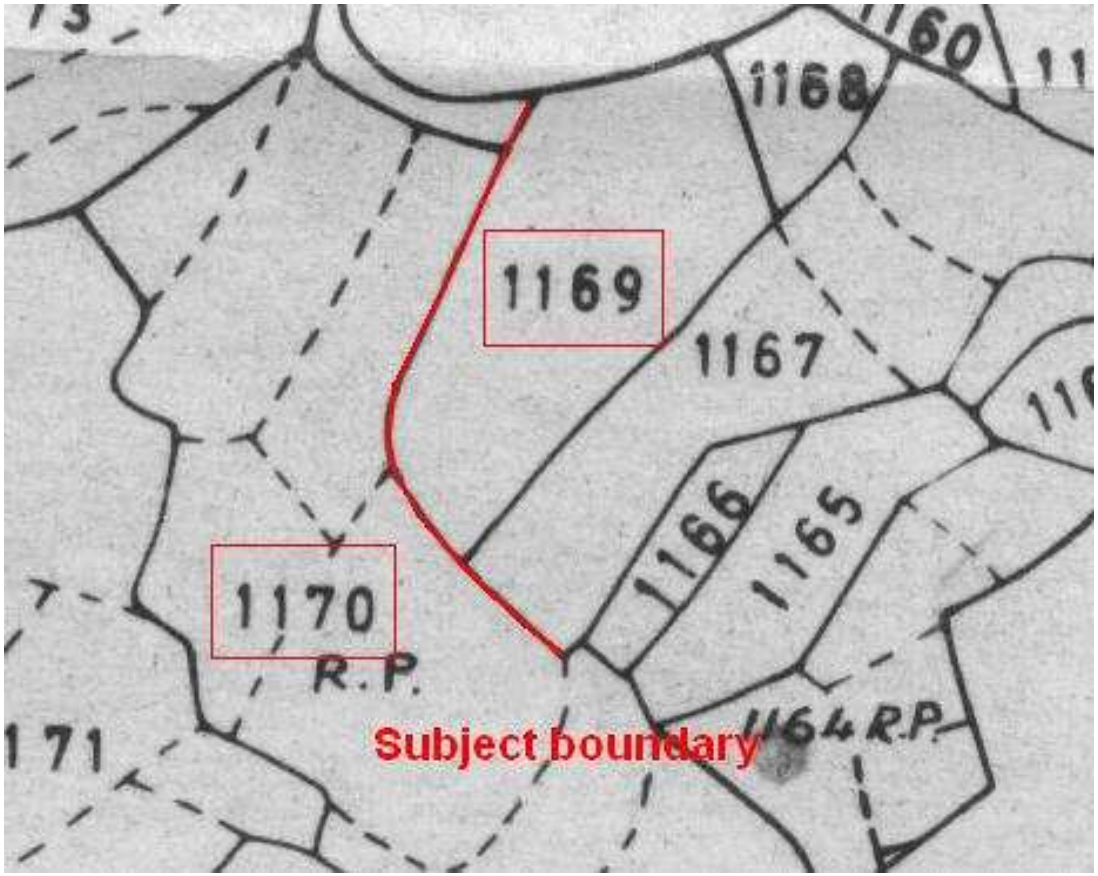
Aerial photo in 2005



Data flow in time



1905 D.D.Sheet



History of DD Survey in NT

- The Demarcation District Survey (DD Survey) was carried out in the period 1899 – 1904 and the DD Sheets were attached to the Block Crown Leases registered mostly in 1905.
- DD survey was done for the identification of land ownership and the collection of government rents.

History of DD Survey in NT

- Over 600 DD Sheets in 477 Demarcation Districts were made.
- A total of about 328,000 lots were shown in the D.D. Sheet

1949 Aerial photograph

10” by 10''

large format

Aerial Photo

No.6016 & 6017

of 1949

no interior

orientation parameters

1963 Aerial photograph

Aerial Photo

Large Format

No.8398

of 1963

1989 Setting-out Plan

- show boundary points by survey marks with horizontal coordinates.

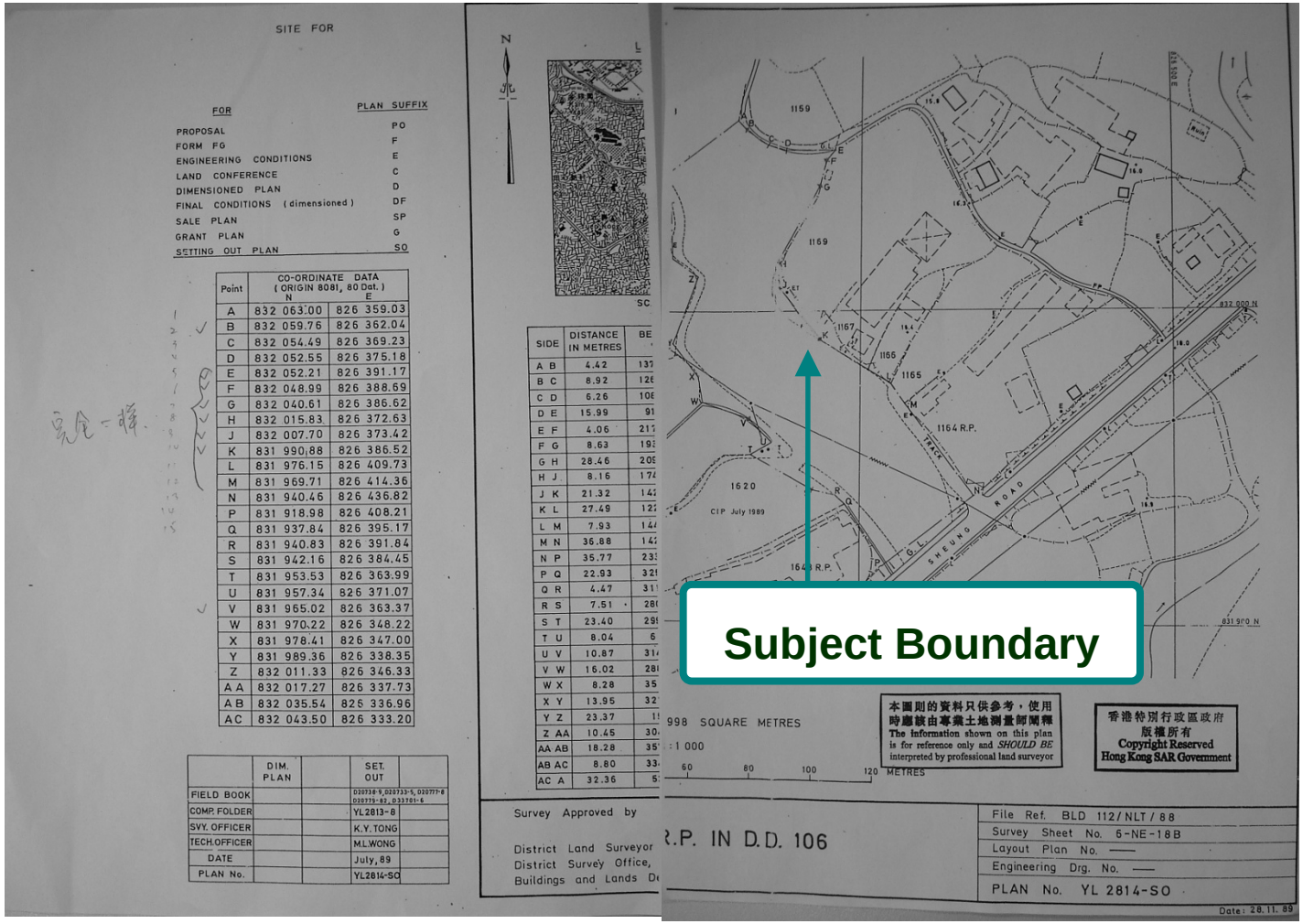
- In 1980's, SRP were usually done by the Government.

Setting-out Plan

Lot 1170RP

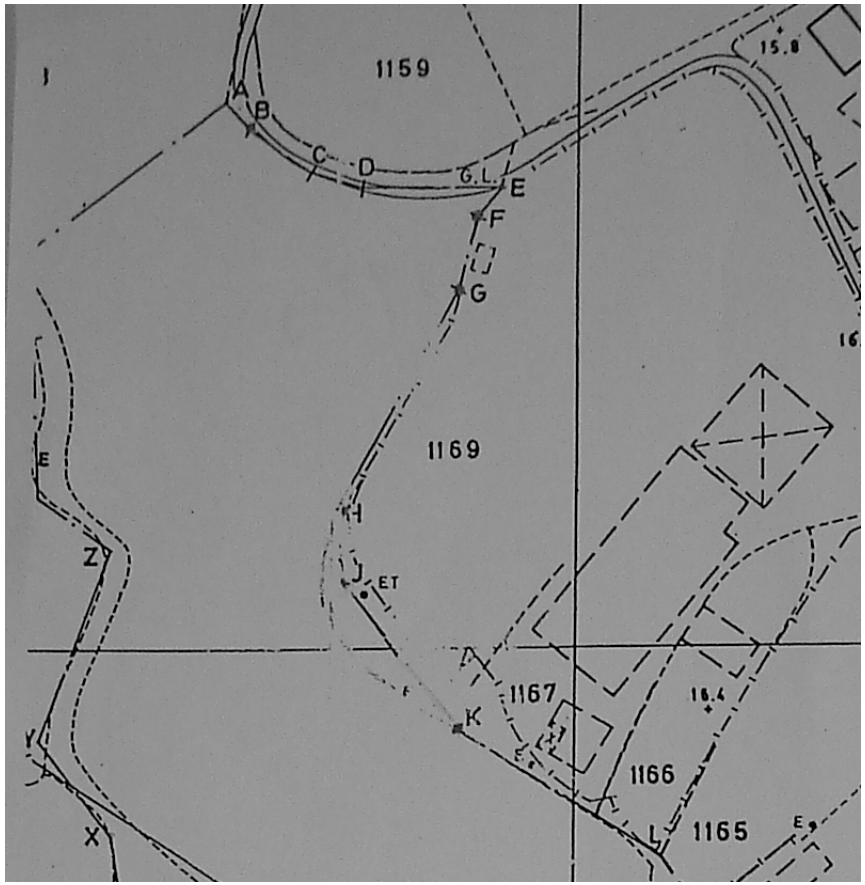
DSO / YL

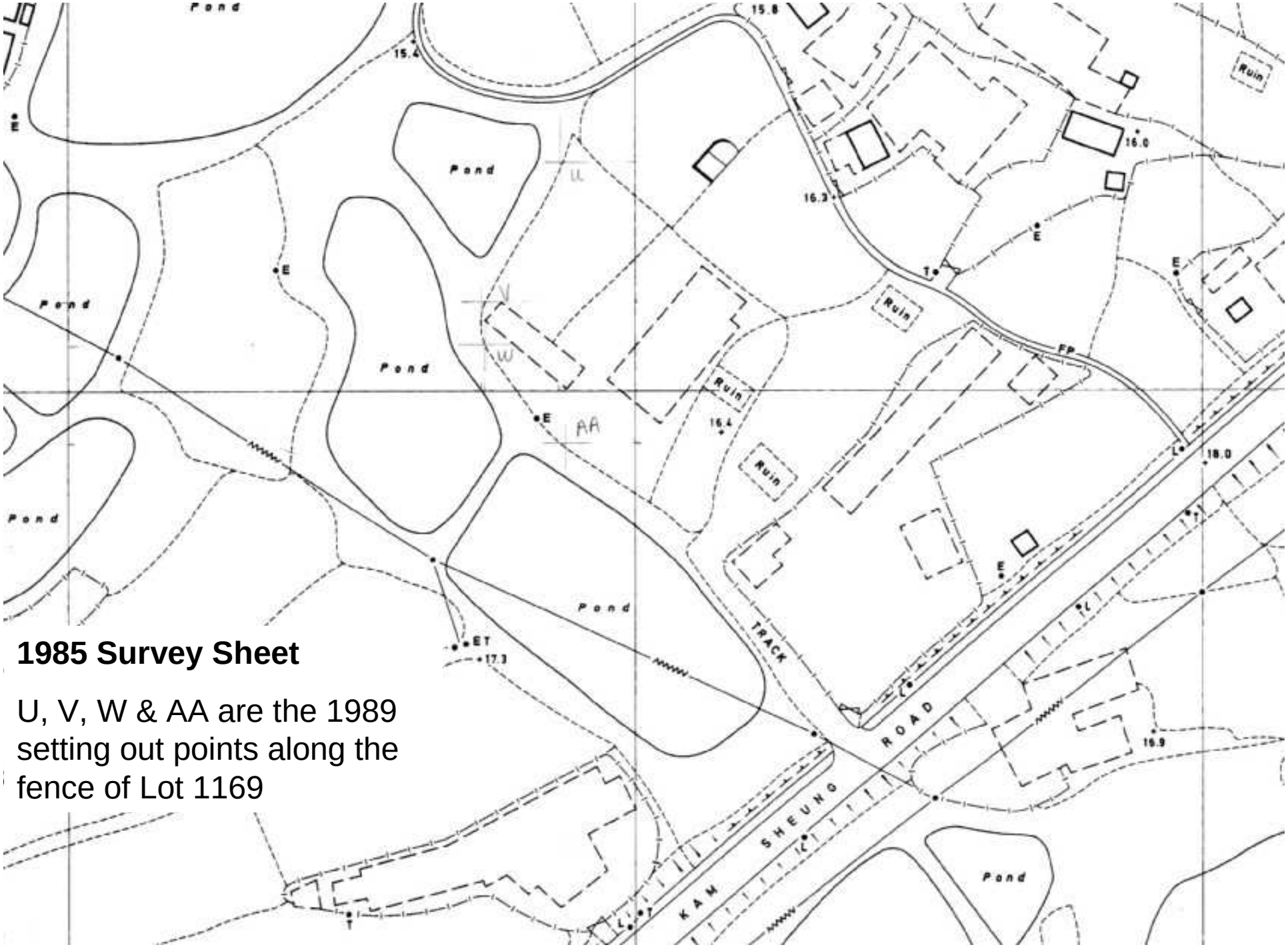
1989



1989 Setting-out Plan of DSO / YL

Point	CO-ORDINATE DATA (ORIGIN 8081, 80 Dat.) N	E
A	832 063.00	826 359.03
B	832 059.76	826 362.04
C	832 054.49	826 369.23
D	832 052.55	826 375.18
E	832 052.21	826 391.17
F	832 048.99	826 388.69
G	832 040.61	826 386.62
H	832 015.83	826 372.63
J	832 007.70	826 373.42
K	831 990.88	826 386.52
L	831 976.15	826 409.73
M	831 969.71	826 414.36
N	831 940.46	826 436.82
P	831 918.98	826 408.21
Q	831 937.84	826 395.17
R	831 940.83	826 391.84
S	831 942.16	826 384.45
T	831 953.53	826 363.99
U	831 957.34	826 371.07
V	831 965.02	826 363.37
W	831 970.22	826 348.22
X	831 978.41	826 347.00
Y	831 989.36	826 338.35
Z	832 011.33	826 346.33
A A	832 017.27	826 337.73
A B	832 035.54	826 336.96
A C	832 043.50	826 333.20

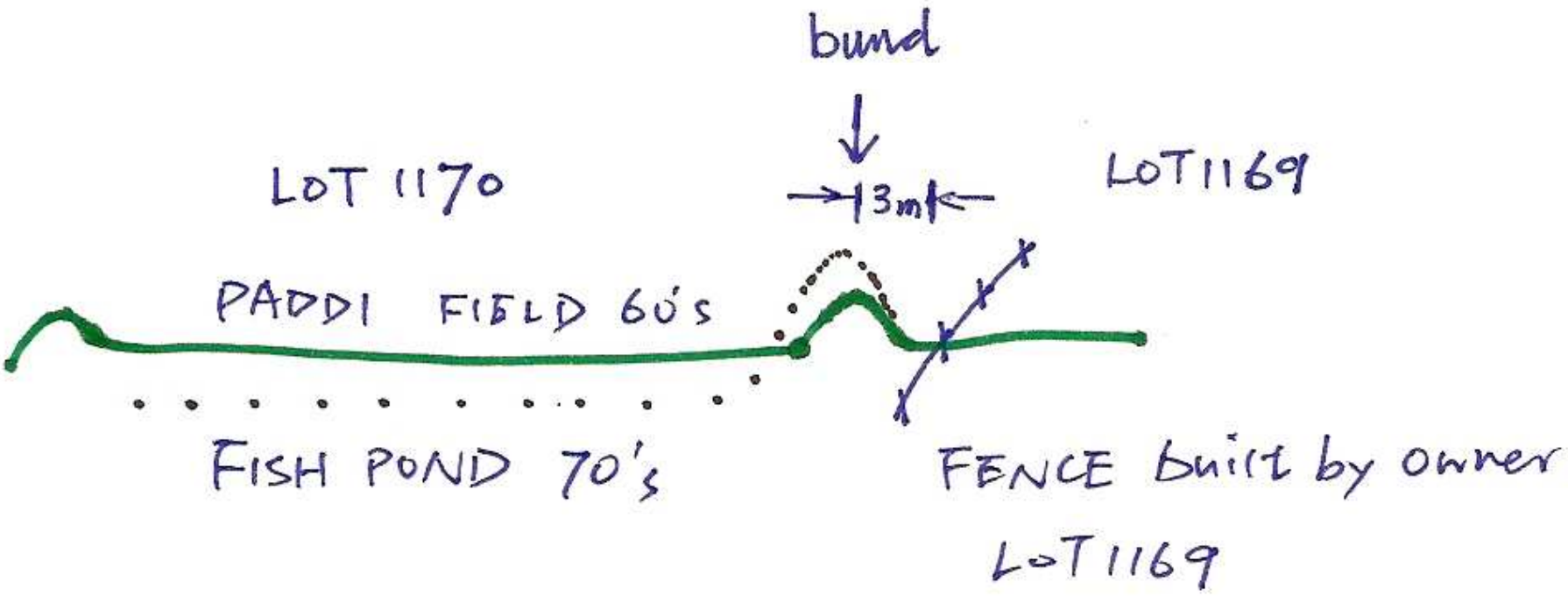




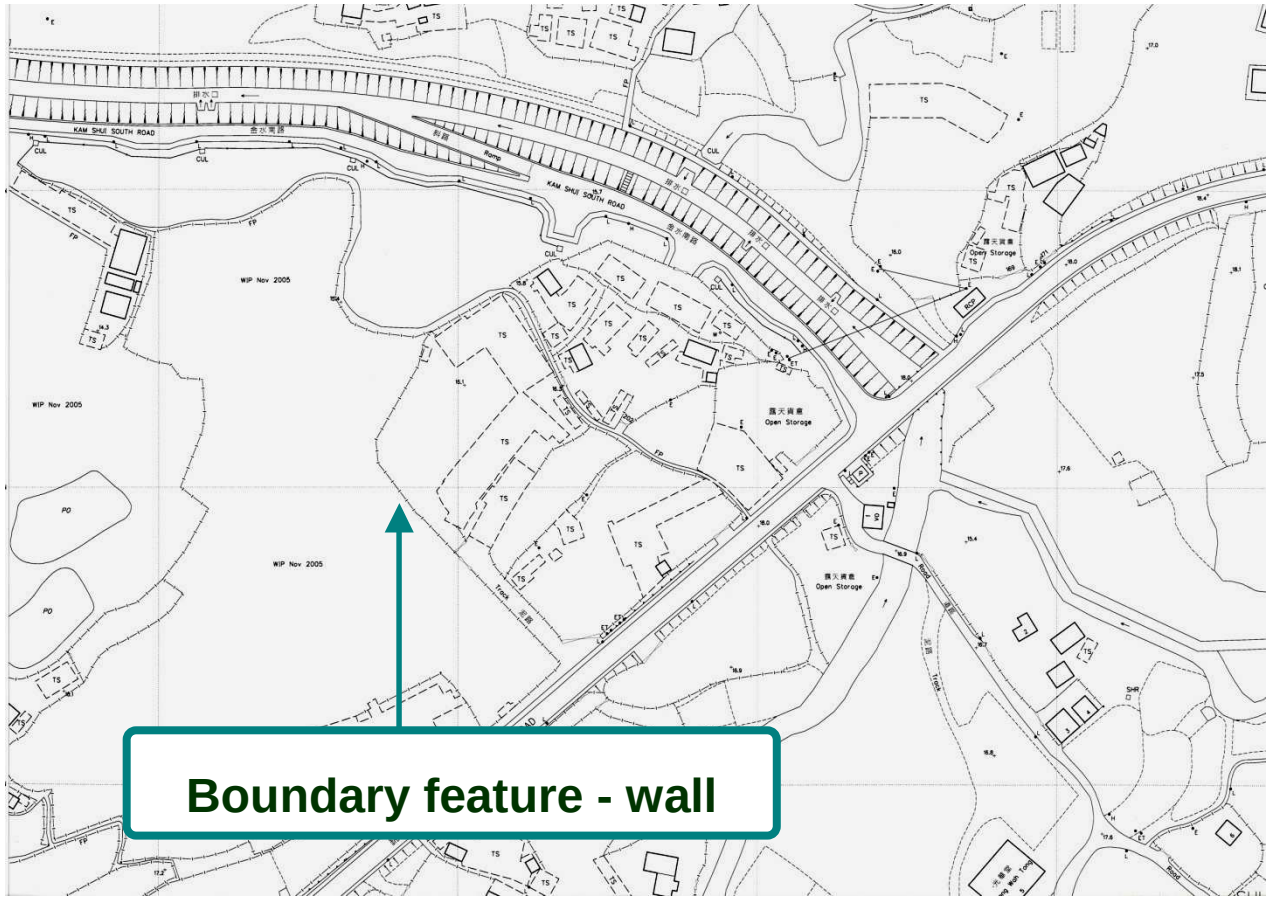
1985 Survey Sheet

U, V, W & AA are the 1989 setting out points along the fence of Lot 1169

View from the owner of Lot 1169



2005 Survey Sheet

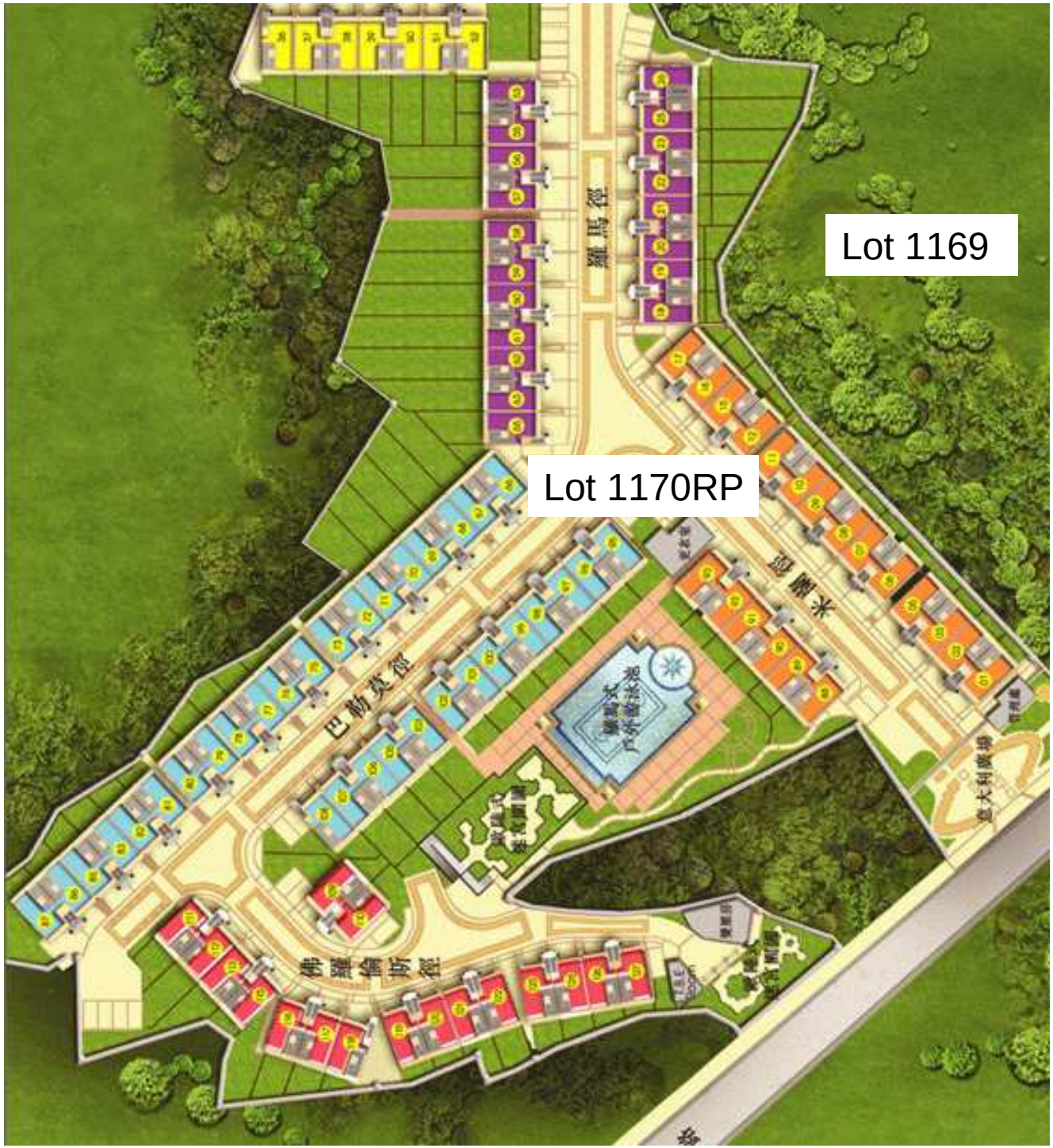


Survey Sheet

2005

Scale: 1:1000

1980 Grid



By 2007,

Lot 1170RP was developed into a group of semi-detached villas

Target points coordinates in 2008

The marked points are the wells, road junctions and bridge pillar that have existed till today

KGPS – accurate to 2 cm

The marked points are surveyed with KGPS

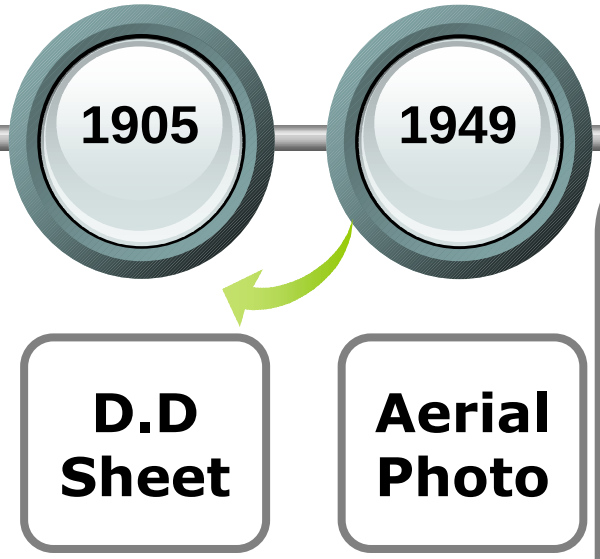
W2 – ‘key-in’ & ‘measured’

Point No.	Northing	Easting	R.L.	Remarks
W1	832548.100	826695.400	18.901	Key-in
W2	832306.200	826661.600	18.901	Key-in
W5	831779.500	826706.300	18.901	Key-in
W8	831569.200	826846.600	18.901	Key-in
W9	831609.000	826922.400	18.901	Key-in
B11	832182.390	826386.571	15.862	
P10	831582.598	826657.810	20.869	
W11	832182.000	826386.900	18.901	Key-in
B4_1	831953.948	826789.359	18.901	
S1_1	832547.315	826695.932	17.109	
USM3	831962.934	826468.215	18.061	
USM4	831964.916	826469.043	12.209	
W10C	831903.480	826062.070	16.622	
W2_1	832303.529	826661.211	17.134	
W2_2	832302.922	826661.306	17.160	
W2_3	832303.344	826660.686	17.157	
W2_4	832304.047	826661.095	17.154	
W2_5	832303.634	826661.809	17.160	
W3_1	832306.007	826765.062	17.924	
W3_2	832305.861	826764.291	17.927	
W3_3	832306.915	826764.712	15.151	
W3_4	832306.056	826765.861	17.898	
W3_5	832306.713	826765.122	17.916	

Data process

Houses on Lot 1170RP were built in 2005, and exist in 2008.

So the survey map 2005 shows existing occupation features.



Developments started in the 1960's gradually gave landscape and land use changes to the New Territories.

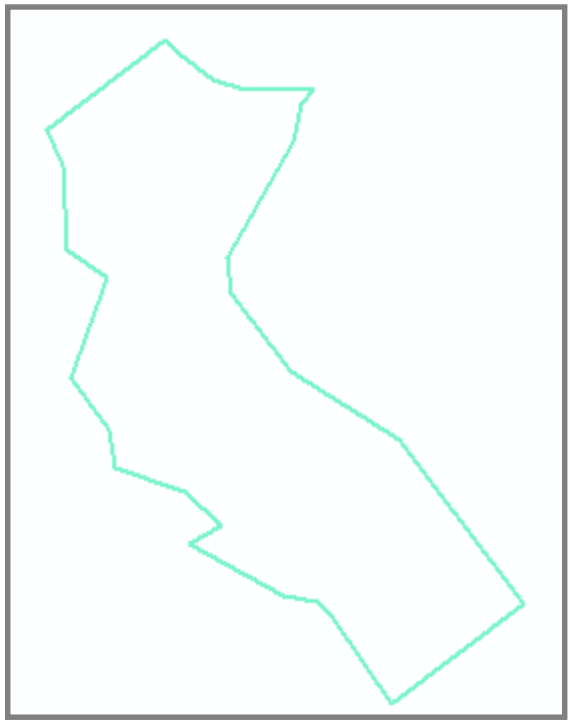
An acurrate map of 1949 can faithfully portray the field-bunds (lot Boundaries)

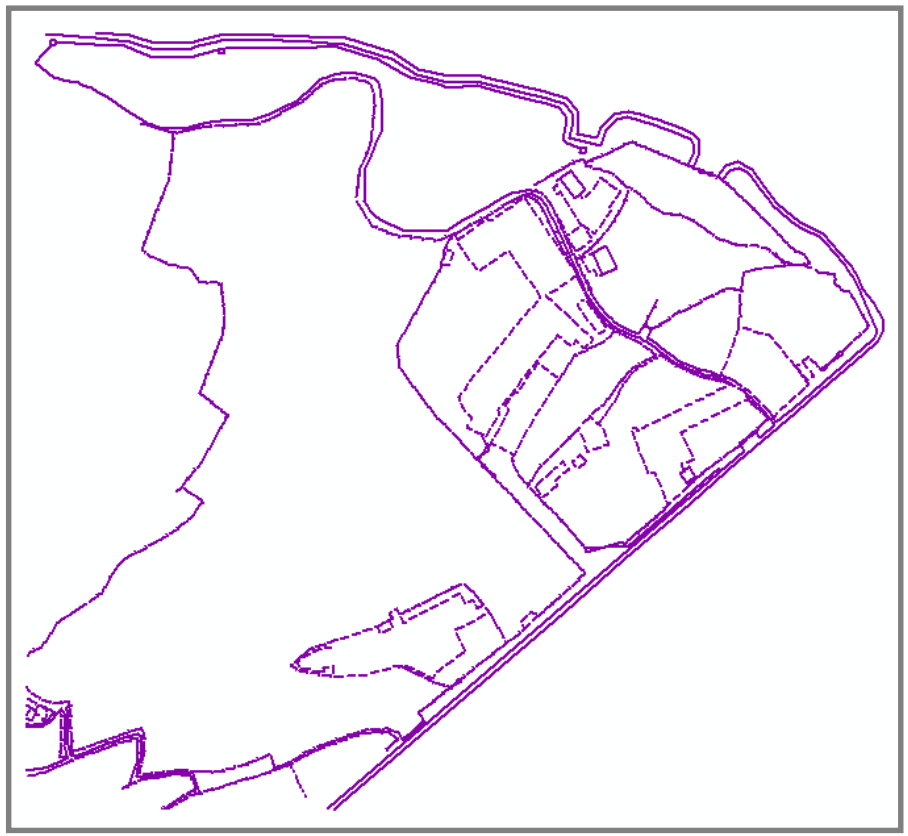
1989

2005

Setting-out Plan

Survey Sheet





1989

2005

Setting-out Plan

Survey Sheet

1989

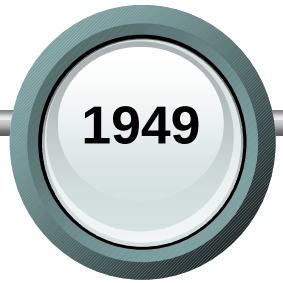
2005

Setting-out Plan

Survey Sheet

The subject boundary features of two maps match well.

So the boundary was unchanged from 1989 to 2005.



Aerial Photo

Setting -out Plan

The Aerial photograph in 1949 and the Setting-out Plan in 1989 are in different projections.

Correct the aerial photograph in 1949 and compare with the Setting –out Plan in 1989.

Correct the aerial photo in 1949

- Aerial photography adopts central projection.

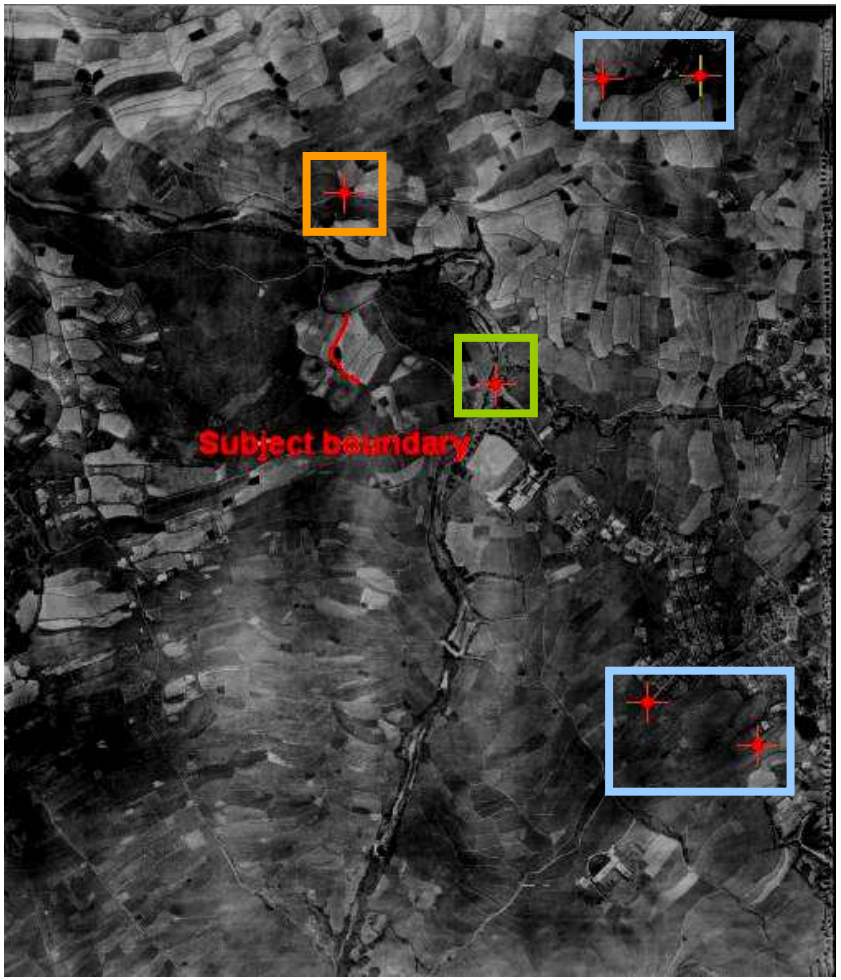
The roughness of the terrain and the tilt of the camera produce geometric deformation.

- Use Ground Control Points to correct the image.

Correct the aerial photo in 1949

- Select control points with GPS surveyed coordinates.
- The vicinity is a plain with height difference within 2 meters down from east to west.
- Applied geometric correction to the aerial photo in Arc Map (Similarity Transformation only)

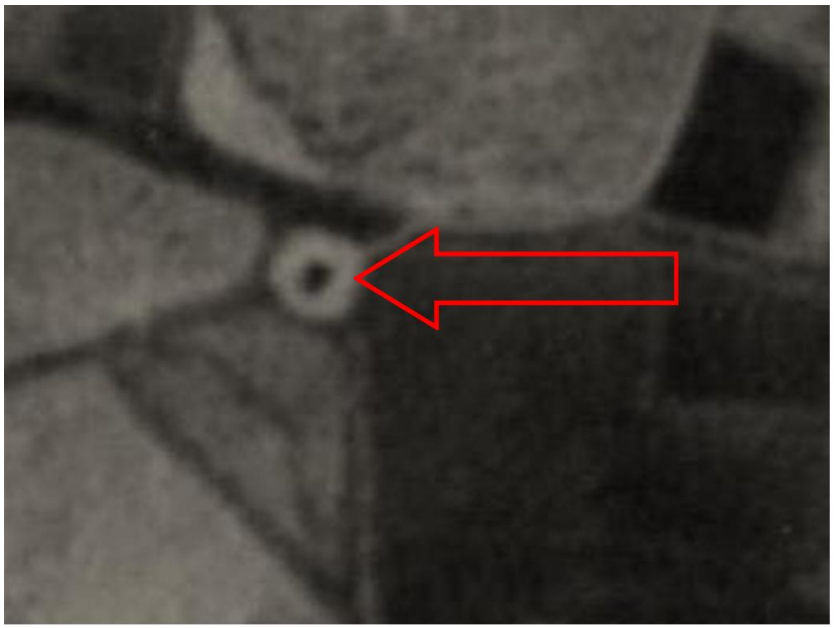
Select control points on 1949 photo



6 identified features were selected as control points.

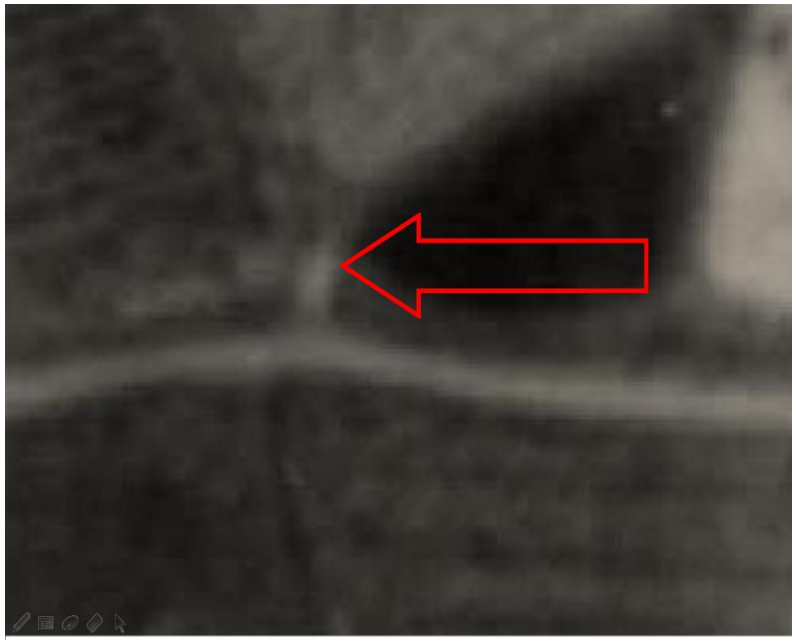
- Well
- Stone plate
- Bridge foundation stone

Select the control points - Well

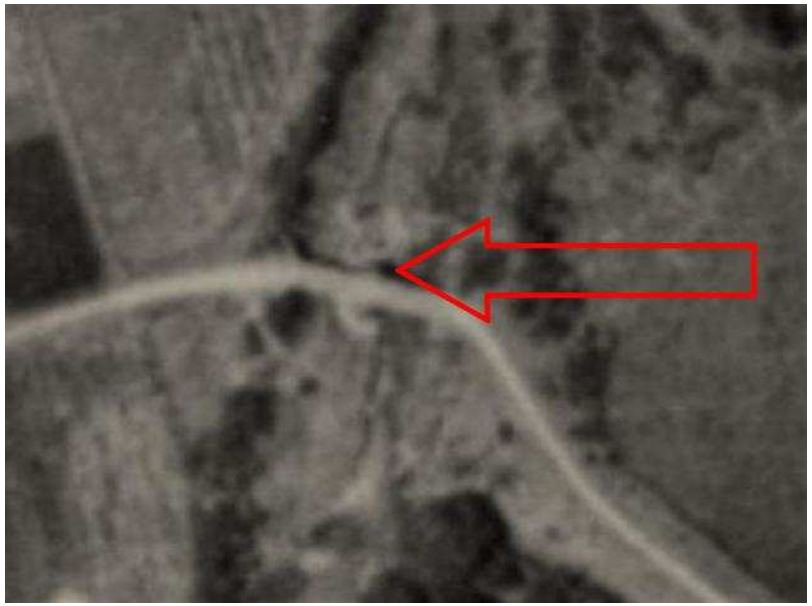


KGPS measurement in village

Select the control points – stone plate



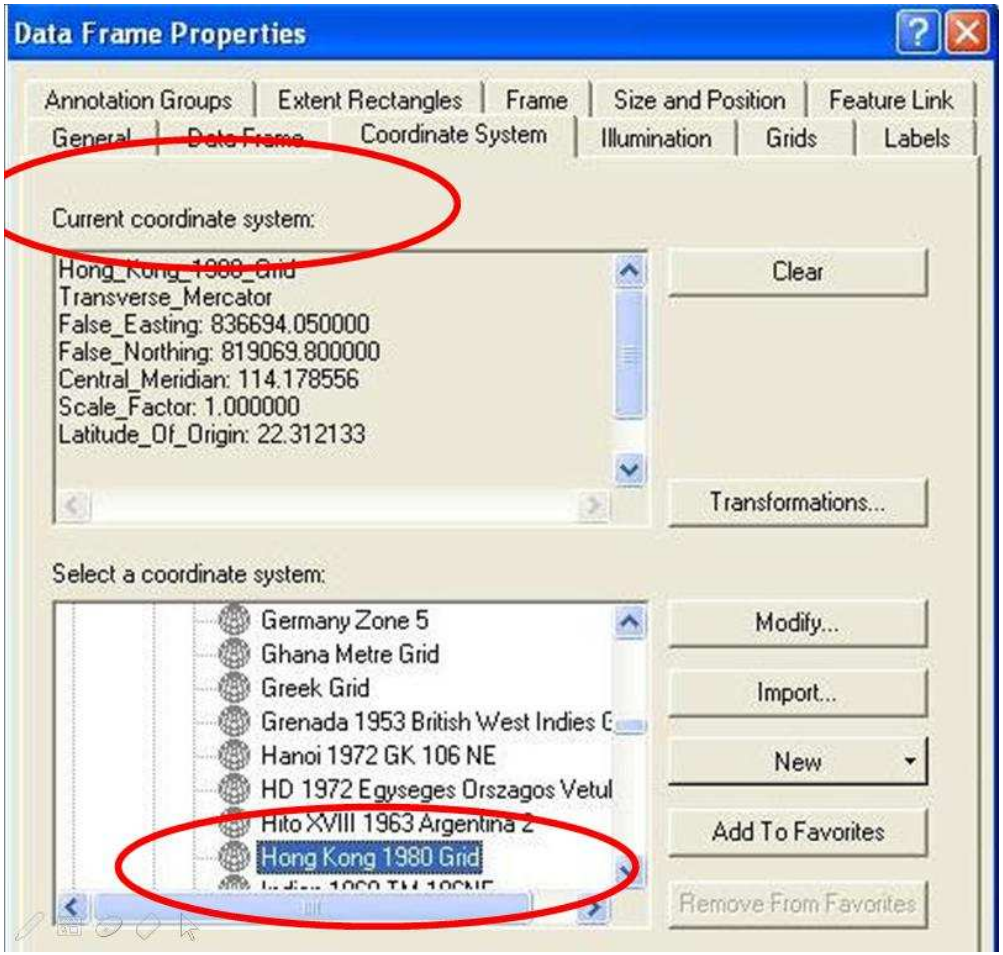
Select the control points – bridge foundation pillar



Shrine now under a big tree; not used

Geometric correction

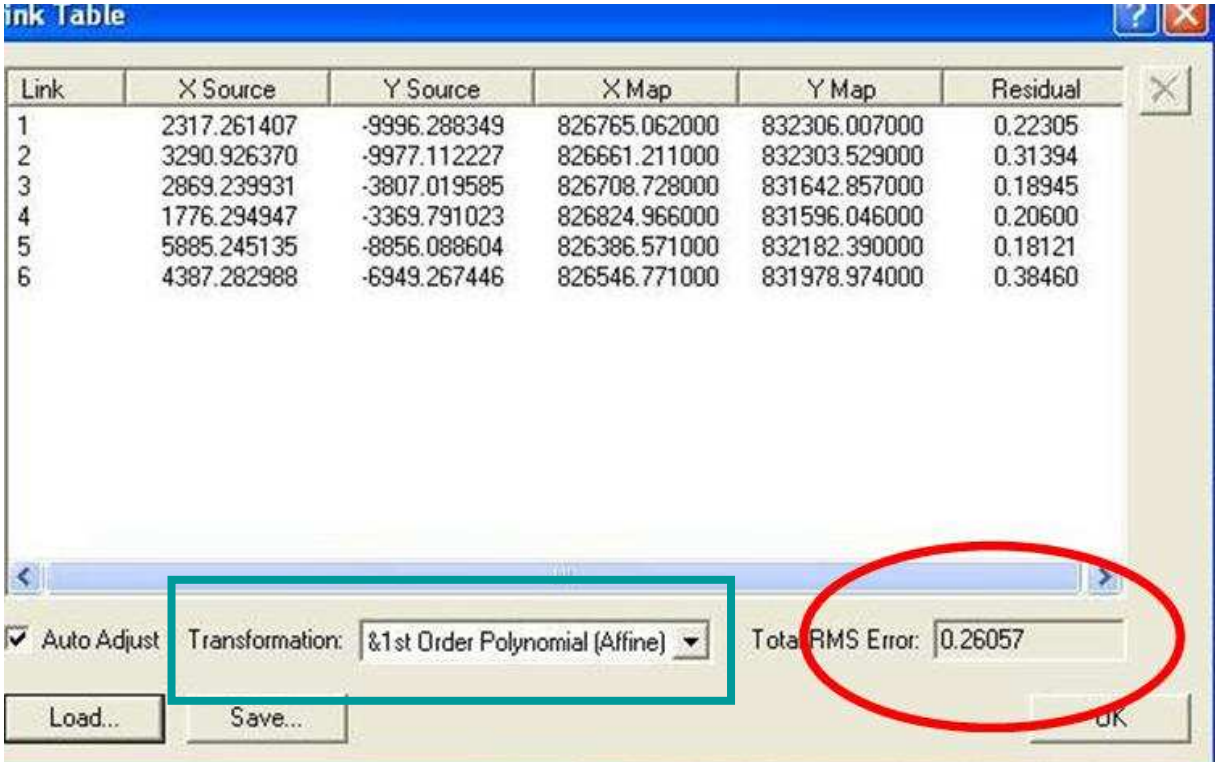
Select a coordinate system in Arc Map



Geometric correction

Add 6 control points in aerial photo in 1949.

Get the Total RMS.

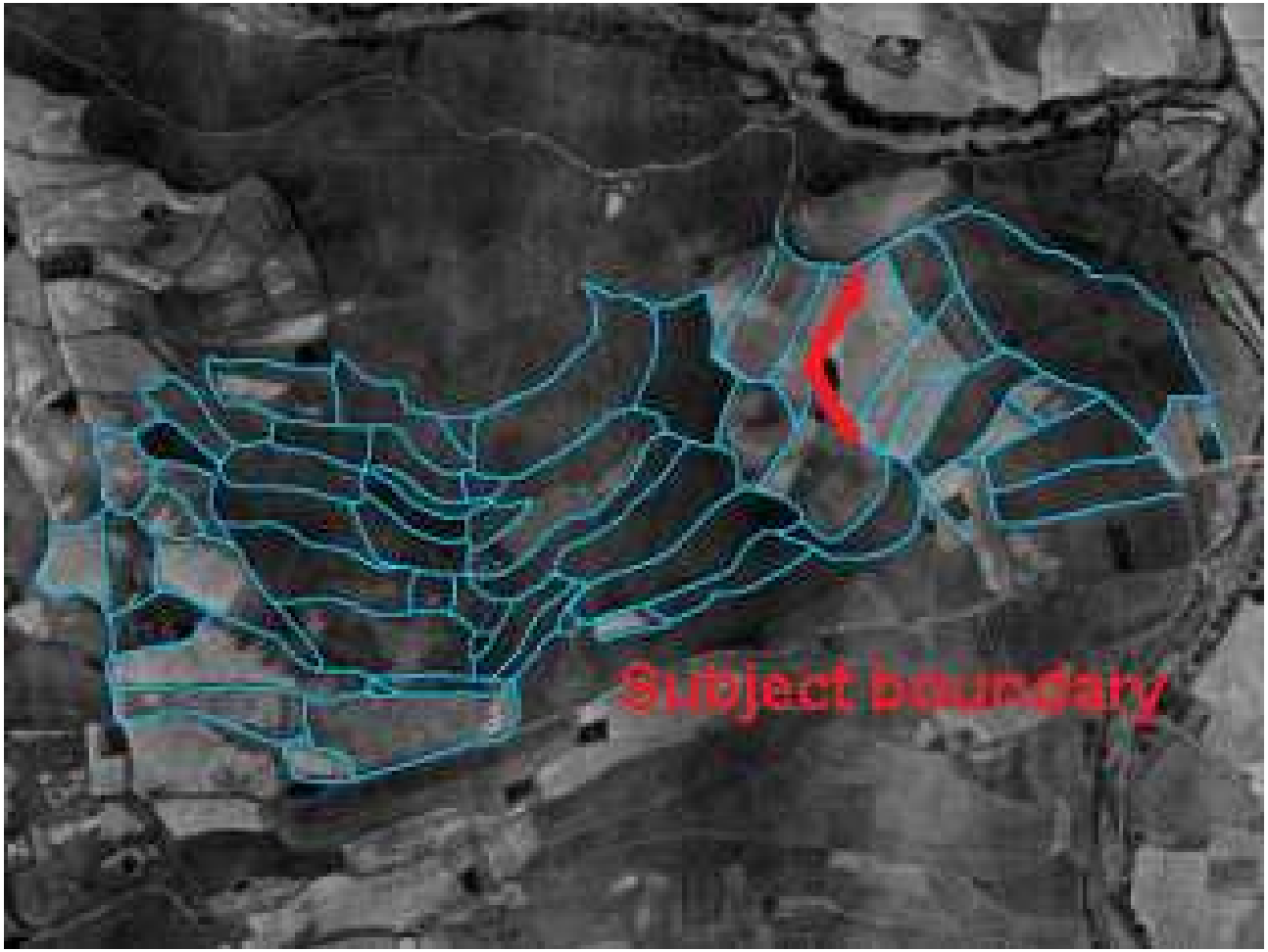


Geometric correction

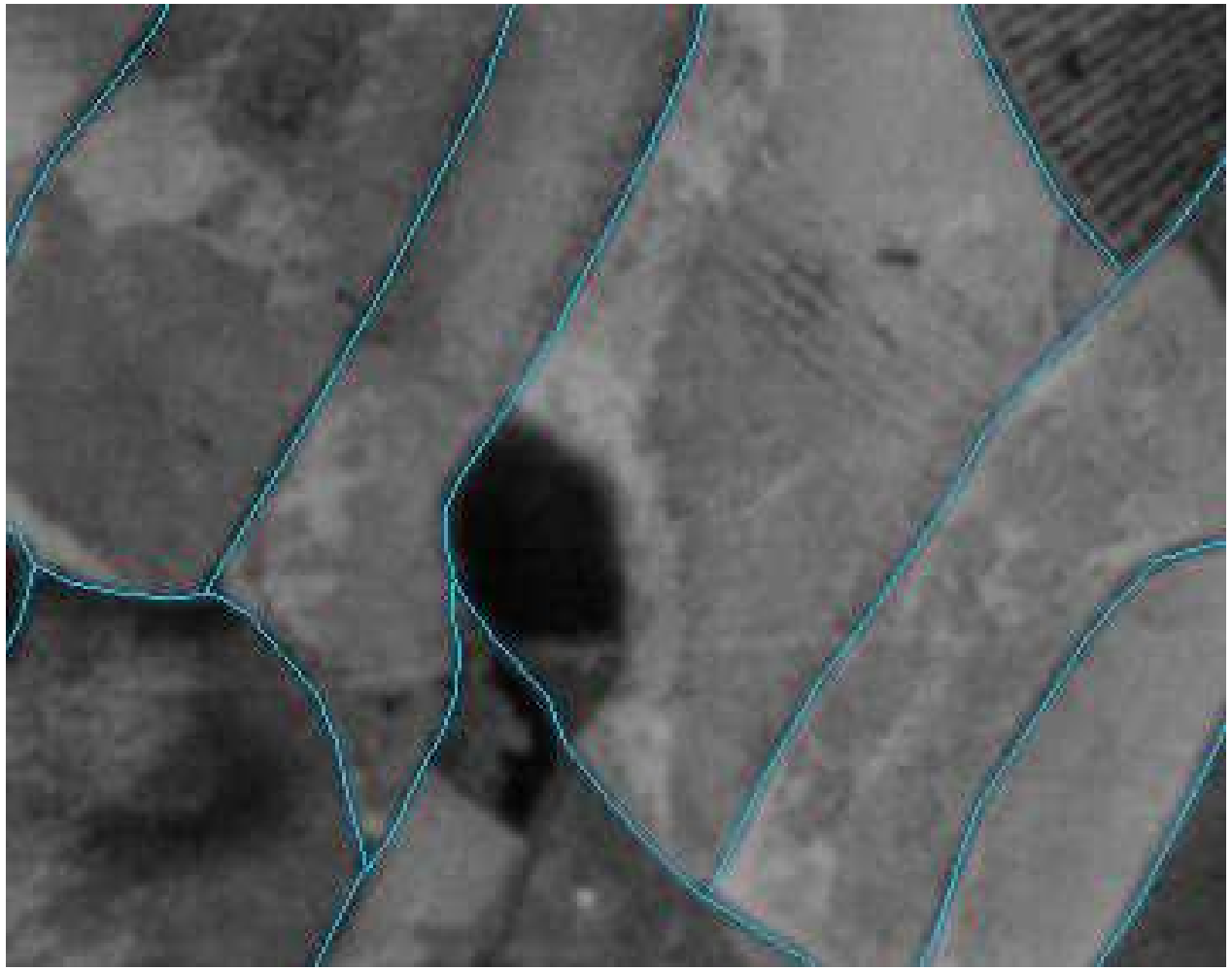
- **The relation equation of 1st Order Polynomial**
- **X= xa+yb+c**

  Y=xa'+yb'+C'
- **(X, Y) is the ground coordinates of the GCP;**
- **(X', Y') is the screen coordinates of the GCP**
- **a b c and a' b' c' are the parameters of this equation which is important for calculate parameter of the above two equations.**

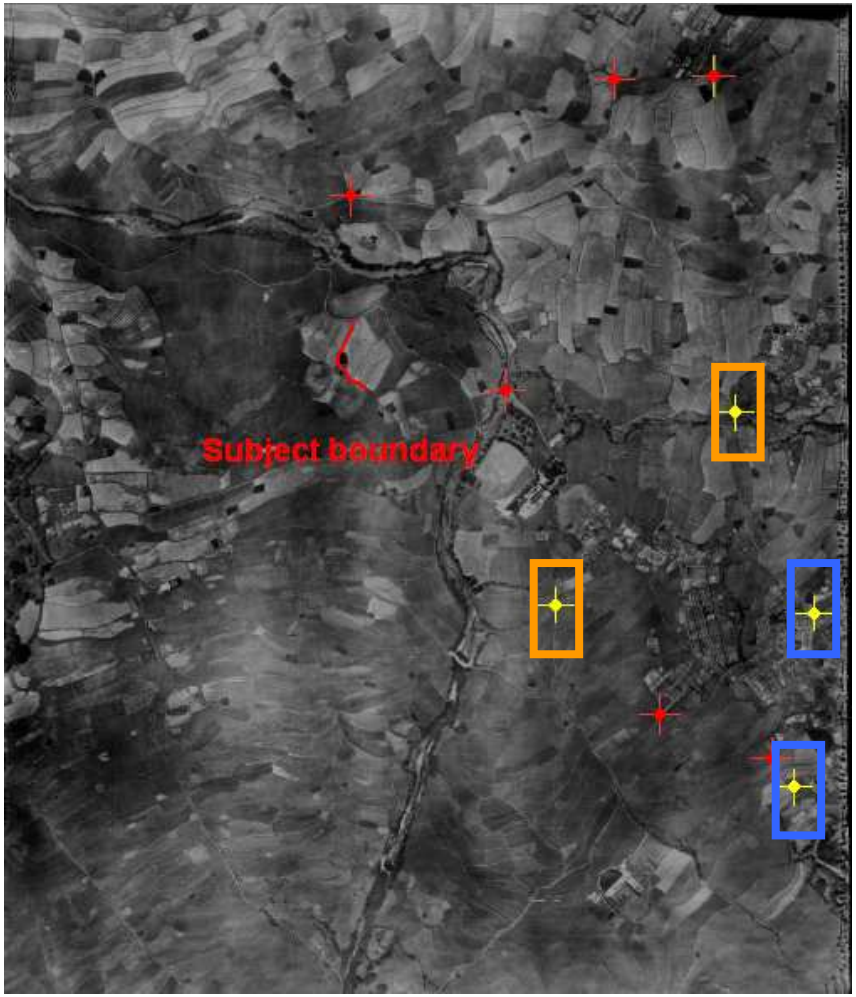
Digitize the aerial photo in 1949



Digitize the aerial photo in 1949



Assess geometric correction



Four testing points were chosen.

- Well
- Road intersection

Checking the geometric correction

Checking the geometric correction

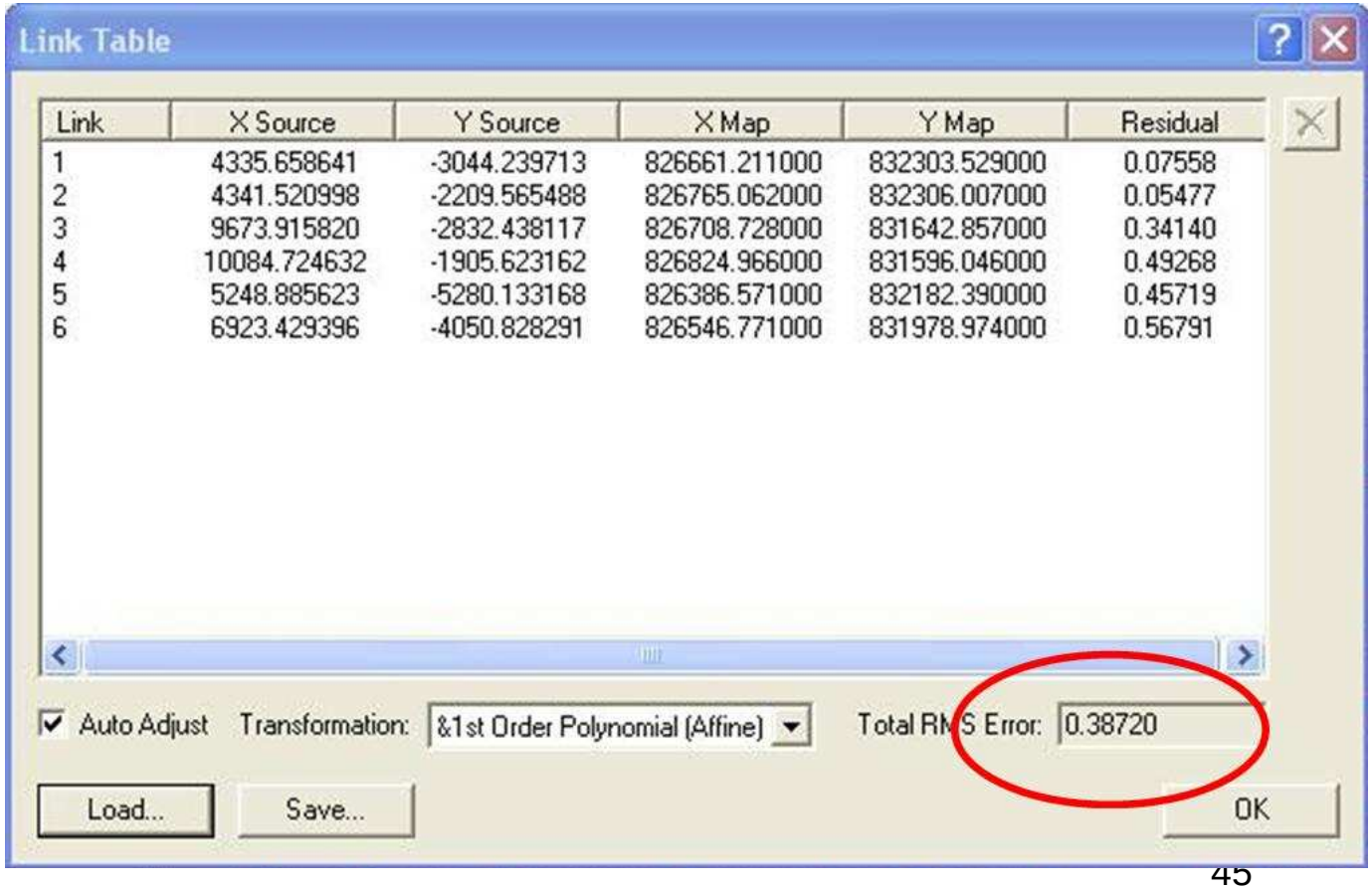
Geometric correction Assessment

	Corrected aerial photograph		GPS survey		Difference
Point	N'	E'	N	E	X
Well 1	831751.55	826866.24	831751.76	826866.39	0.26
Well 2	831954.00	826788.87	831954.14	826789.04	0.22
Intersection 3	831749.16	826600.44	831749.01	826600.82	0.41
Intersection 4	831569.62	826846.92	831569.23	826846.64	0.48
					RMS= 0.36 m

Compare control points in 49’ & 63’ photos

Add 6 control points in aerial photo in 1963.

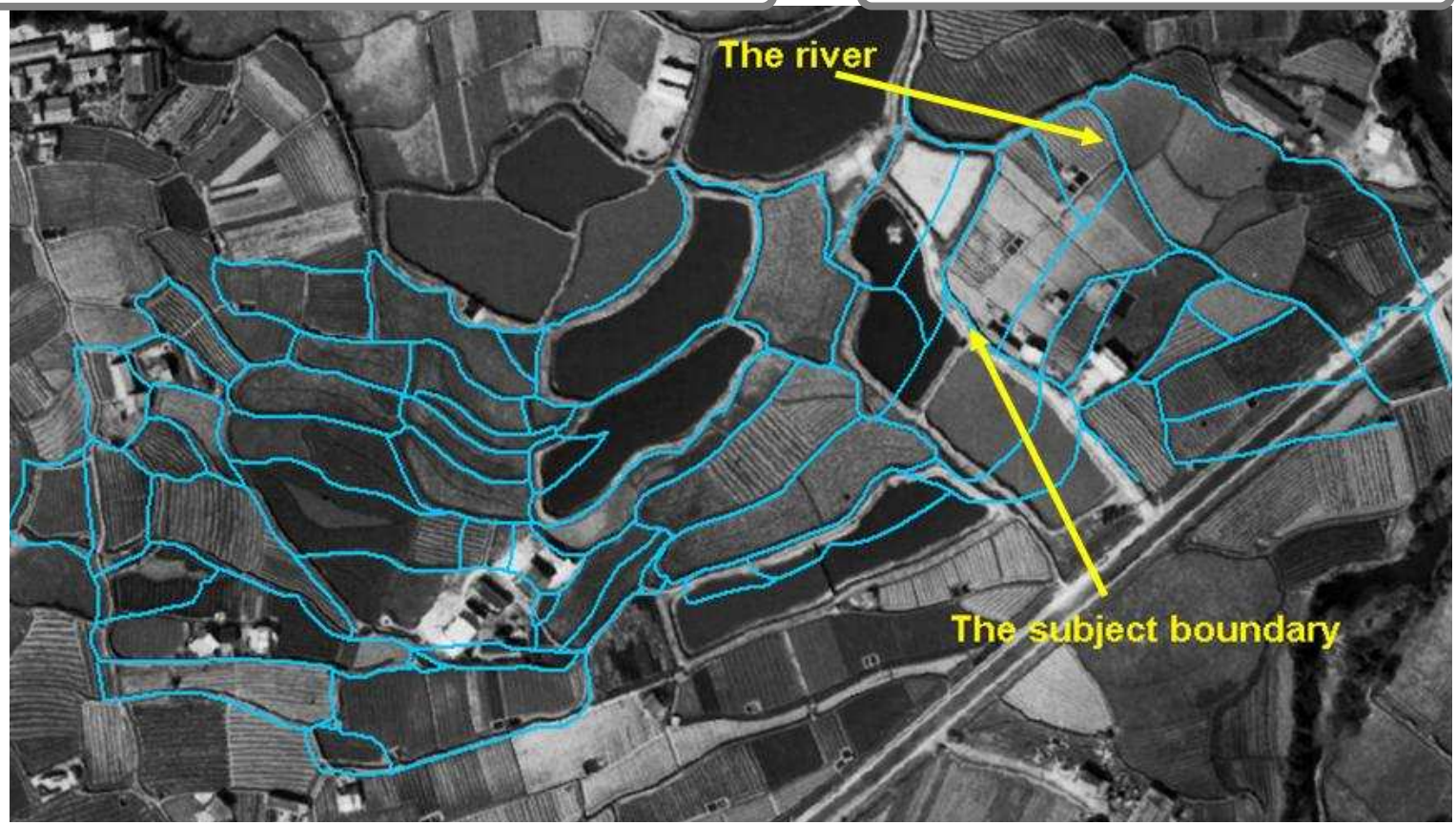
Get the RMS.



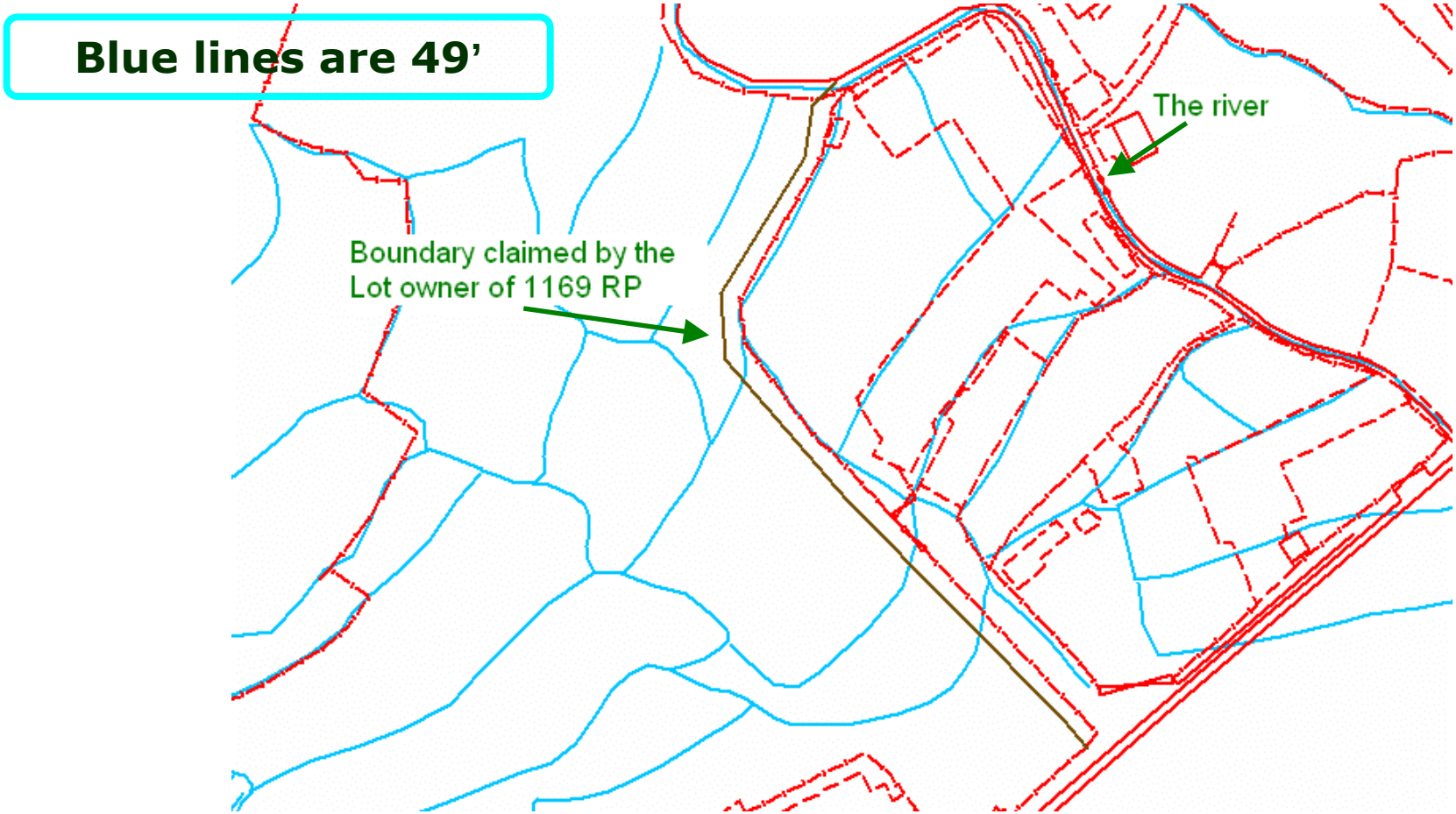
Compare control points in 49’ & 63’ photos

Aerial photo background in 63’

Blue lines are 49’



Compare control points in 49’ & 2005

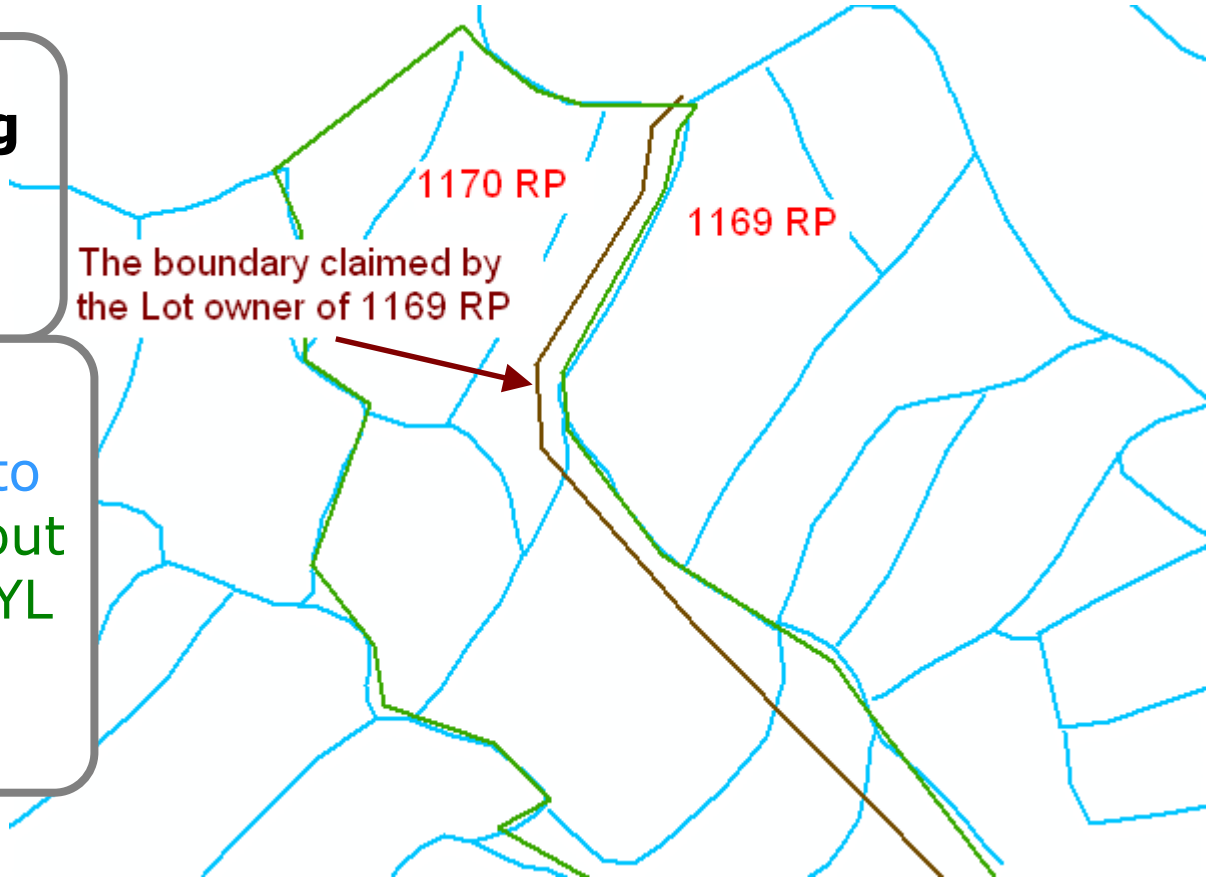


1949

1989

Aerial Photo

Setting -out Plan



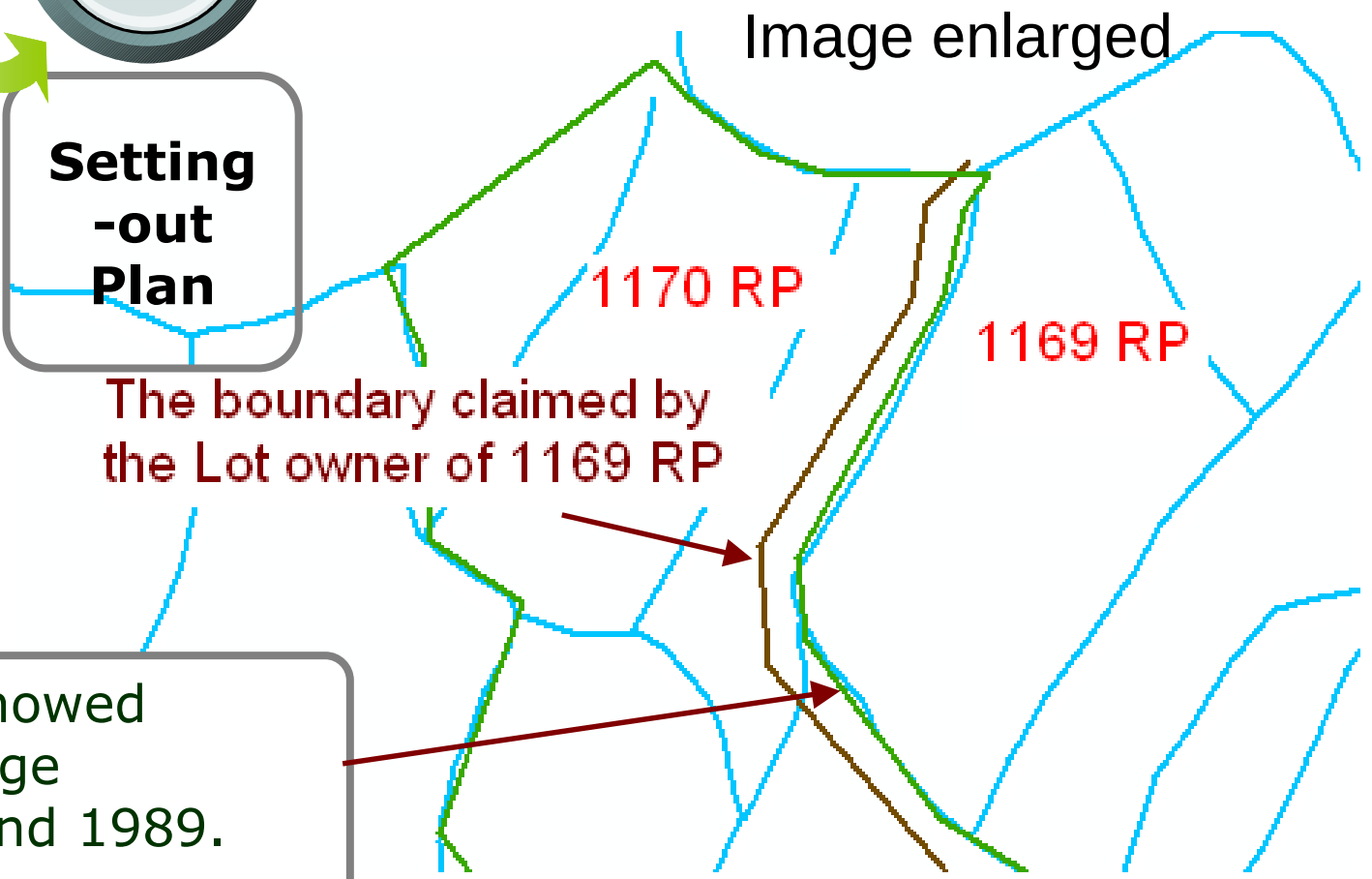
Blue: 1949 Aerial photo
Green: 1989 Setting-out Plan of DSO / YL
Brown: Buffer

1949

1989

Aerial Photo

Setting -out Plan



The boundary showed
no obvious change
between 1949 and 1989.

Conclusion

- NO encroachment.

- And, this is a feasible method to handle similar cases.

Bauhinia (flower of Hong Kong) – photoed insitu on 21 Dec 2007