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# GIS Helps Evaluate Cathodic Protection System for Gas Distribution Pipelines

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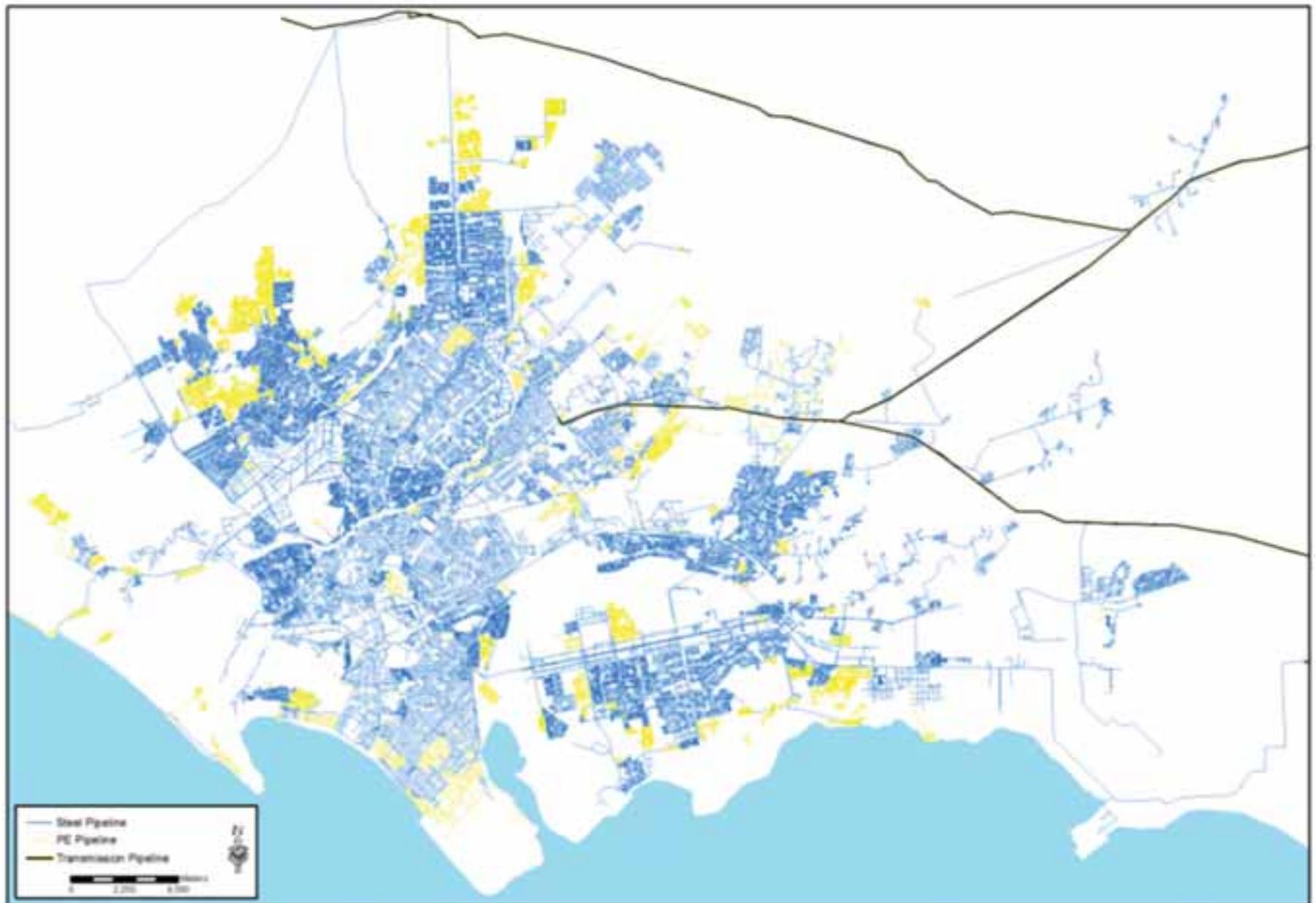
## Background

- ▶ SSGC is one of the natural gas supplying companies in Pakistan, serving southern part *i.e.* Sindh & Balochistan provinces.
- ▶ Gas network contains both Steel and Polyethylene pipelines.
- ▶ Aging, physical activities and underground corrosion contribute to wear & tear of steel pipelines.
- ▶ Cathodic Protection (CP) system is installed by SSGC to prevent steel pipes from corrosion.
- ▶ Impressed current cathodic protection system is used for high/medium pressure supply-mains while sacrificial anode system for low pressure distribution-mains.
- ▶ Maintenance and management of CP system is of core importance for pipeline protection.

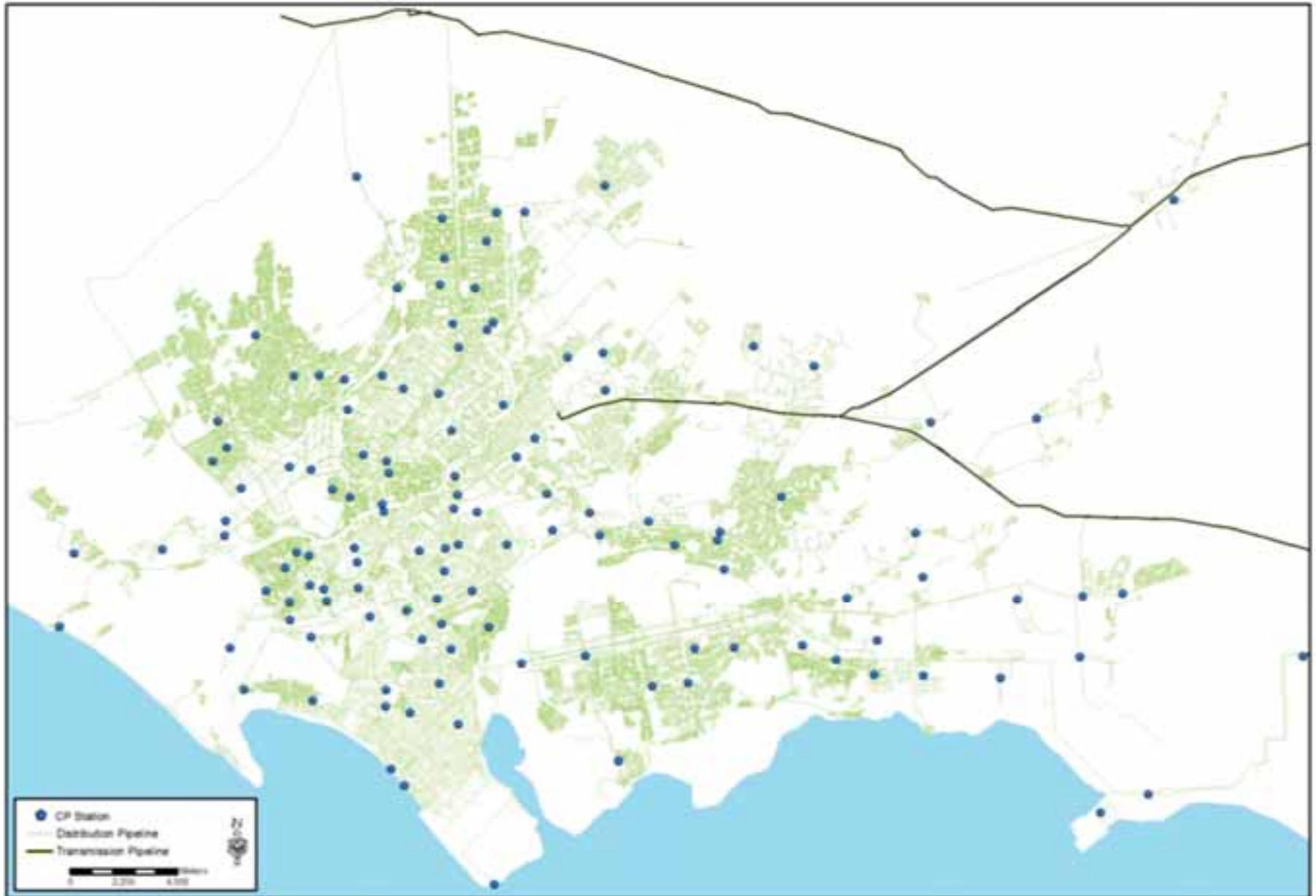
## Background

- ▶ CP department face enormous difficulty to calculate the year-wise length of affected pipelines for replacement with PE, CP system expansion/upgrade and budgeting.
- ▶ SSGC has 2.3 million consumers, connected through 39,253 Km of distribution pipeline network
- ▶ 84.5% of the network is comprised of Steel pipelines laid between 1955 to 2012, and still expanding.
- ▶ Approx. 64% of natural gas consumer base of SSGC exists in Karachi city only.
- ▶ 128 CP stations are operational to protect 7,719 Km steel pipeline network in Karachi.

# Steel & Polyethylene Pipeline Network in Karchi City

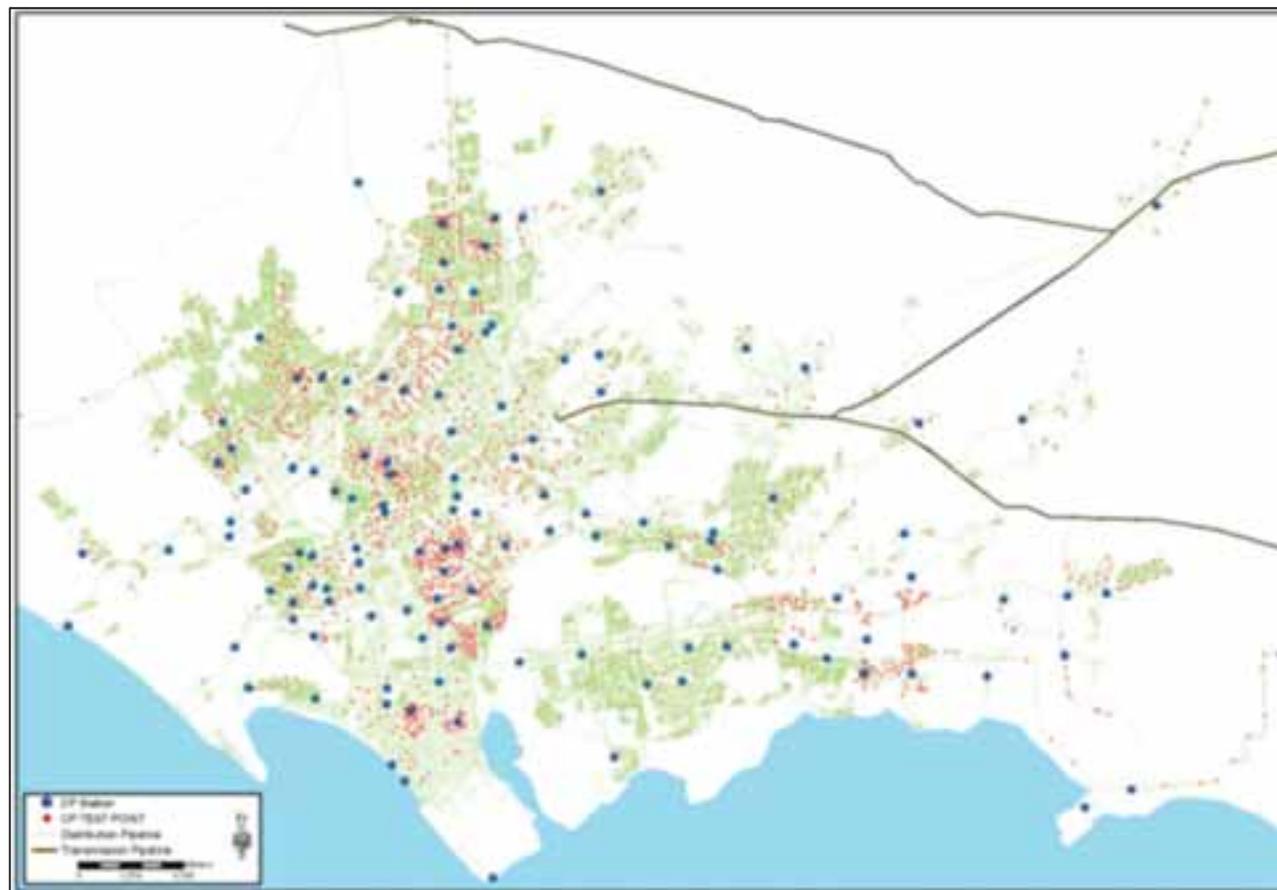


## Operational CP Stations in Karachi City



## Methodology

- ▶ To evaluate the current CP status in Karachi, 1784 CP Test Points (CTP) identified.
- ▶ CP potential values (in Volts) of each CTP attached/added as attributes in CTP point feature class.
- ▶ Each CTP provides only CP potential value (in volts) for the selected pipeline.



## Methodology

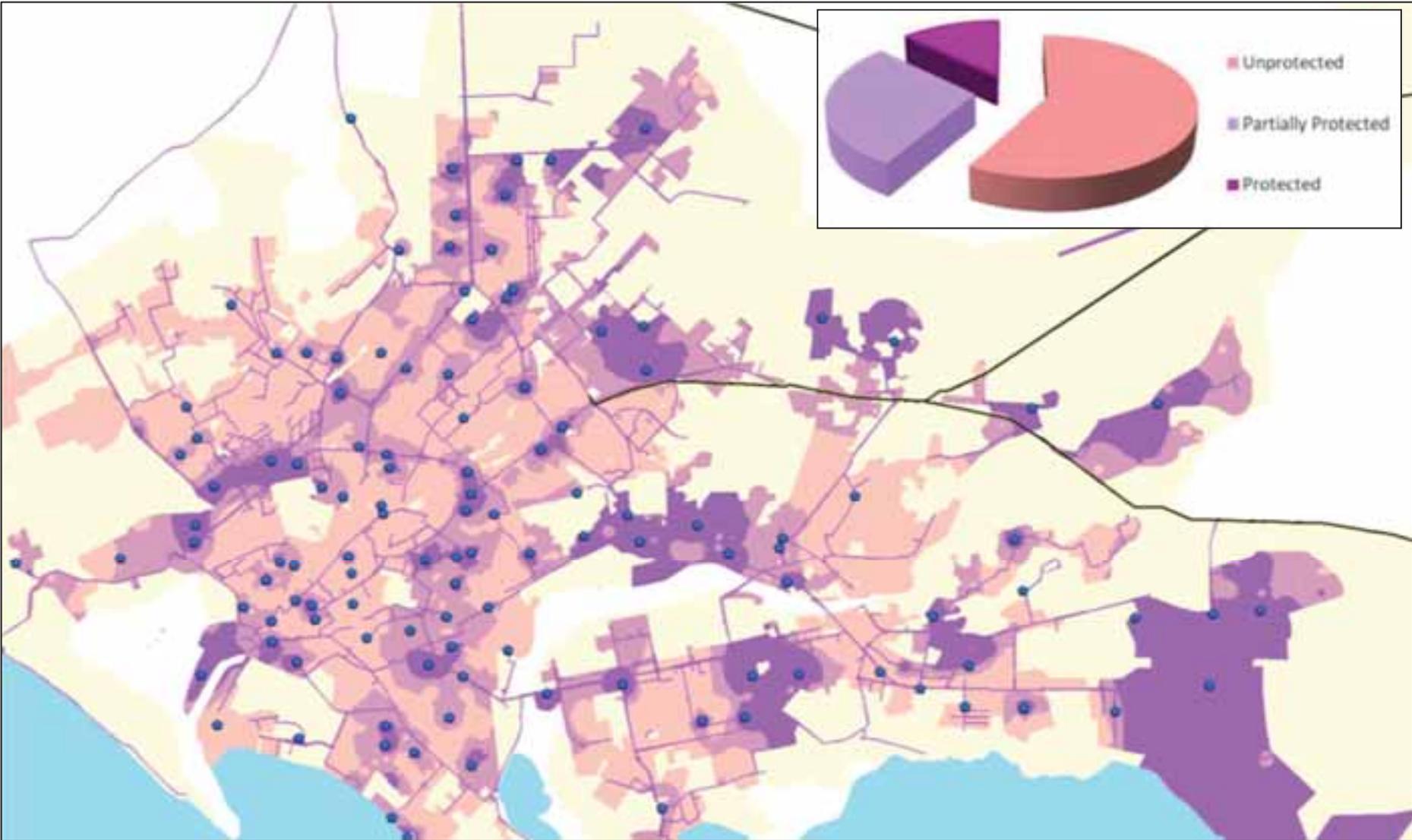
- ▶ ArcGIS Spatial Analyst is used to create a seamless surface of CP potential values.
- ▶ IDW (Inverse Distance Weighted) is selected as interpolation technique, because CP potential values are inversely proportional to the distance from CTP.
- ▶ The IDW surface generated from CP potential values classified into following three classes/categories:

*Protected Area : -0.85 volts-or-higher*

*Partially Protected Area: -0.7 to -0.84 volts*

*Unprotected Area : -0.69 volts-or-lower*

# Classified IDW Surface for CP Potential Values (Volts)

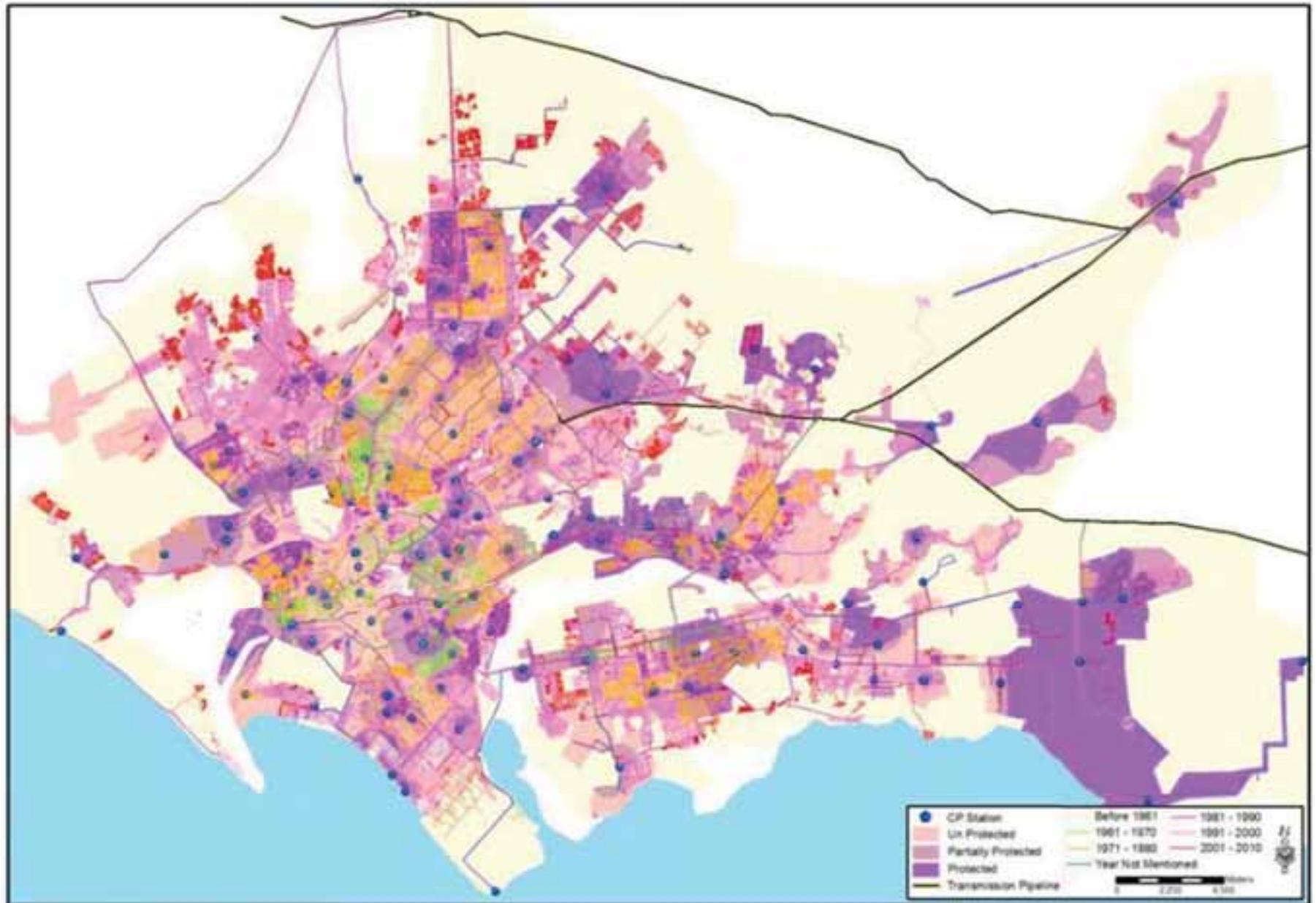


## Methodology

- ▶ The IDW classified surface is converted from Raster to Vector format for overlay analysis.
- ▶ Affected pipelines selected through Overlay function, by Intersecting Vectorised IDW surface with Pipeline feature class.
- ▶ Summary of total pipeline length in each CP potential class is as follows:

<i>Protected Area :</i>	<i>817 KM</i>
<i>Partially Protected Area :</i>	<i>1837 KM</i>
<i>Unprotected Area :</i>	<i>3701 KM</i>

# Year-Wise Pipeline Network in Each CP Potential Class



## Conclusion

- ▶ ArcGIS Spatial analysis proved to be very useful in identifying Protected, Partially Protected and Unprotected pipeline segments.
- ▶ Final CTP Surface revealed that 58% of the pipeline network in Karachi is Unprotected, 29% is Partially Protected and only 13% is well Protected.
- ▶ Year-wise length of pipeline network in each CP potential class helped in estimating budget for replacement of steel pipelines with PE, CP system Expansion/upgrade and maintenance.
- ▶ GIS map shows affected areas as the base for planning of CP system expansions and new installations.