



GIS Strategic Implementation Plan 2019 - 2024

CITY OF IRVINE

CALIFORNIA

GIS Strategic Plan Introduction

The City of Irvine has a robust GIS System. The City's GIS Division, which provides day to day maintenance of the system, worked with a consultant, Geographic Technologies Group (GTG) to make it even more impressive. Strong organizations—especially ones that use an ever-evolving technology such as GIS—continually plan for future developments and updates to their current product offerings. Developing a GIS-specific Strategic Plan ensures that departmental and division leadership are on the same page when it comes to identifying how GIS empowers internal staff, as well as clients and external stakeholders.

We want to provide great support, training, system integration, and innovation. As part of this Strategic Implementation Plan we have embarked on creating a five-year GIS strategic plan that will help the City implement best in class GIS technology, enhance business process with GIS, increase the visibility of GIS in the organization, and improve citizen access of public information using GIS.

The goals for the strategic plan include:

- To enhance GIS service delivery with improved efficiency and effectiveness
- To expand GIS accessibility and use
- To achieve a greater level of integration of GIS with the City's business systems
- To better support City business processes
- To increase organizational awareness, visibility, and department sponsorship for GIS
- To implement best in class GIS technology.

The methodology undertaken in conjunction with GTG included:

1. Perform a Self-Assessment
2. Consultant performs needs-assessment
3. Creation of conceptual system design
4. Strategic implementation plan
5. Self-assessment tool

The following pages contain the seven documents delivered as part of the project that comprise the Strategic Implementation Plan and an Enterprise Data Assessment and Management Plan.

These documents are:

1. Voice of the Customer
2. KPIs and Benchmarking Report
3. GIS Needs Assessment Report
4. Data Assessment and Enterprise Data Management

5. Technical Readiness
6. Organizational Readiness
7. Implementation Plan

GIS Questionnaire – Voice of the Customer

City of Irvine | CA

Painting a clearer picture of the state of your GIS initiative today with the help of those who share a vested interest.

Table of Contents

VOICE OF THE CUSTOMER (VOC) SURVEY 1

Questionnaire ConclusionsConclusions 3

Q1 What department do you work in?.....4

Q2 On a scale of 1-10, how would you rate your level of GIS expertise?5

Q3 On a scale of 1-10, how well do the current GIS solutions and services available to you support you in your role?.....6

Q4 In which areas have GIS helped you in your role or improved processes for you or your organization?7

Q5 Does your organization have a master data list containing a full inventory of GIS data sets and map layers as well as information on the storage and upkeep of each? .8

Q6 How often do you create new or modify existing GIS data or metadata? 10

Please rate the accuracy, reliability and completeness of the following critical data layers:..... 12

Q7 Address Points 12

Q8 Parcels 13

Q9 Street Centerlines 14

Q10 Aerial Photography..... 15

Q11 Of the data sets and map layers you have used, are there any that seem inaccurate or incomplete? 16

Q12 Are there any datasets or map layers that would be useful to you but are currently inaccessible or non-existent?..... 18

Q13 How would you describe the GIS database structure at your organization? 20

Q14 On a scale of 1-10, how easy is it to find GIS datasets or map layers you need to fulfill your job duties?..... 21

Q15 Can you think of an instance where data is being stored and maintained by separate individuals or departments, a situation which could result in duplicated and/or conflicting information across separate mediums? 22

Q16 On average, how often are you using GIS? 24

Q17 How would you rate your organization's commitment to making the most up-to-date GIS solutions available to you?..... 25

Q18 Which of the following Esri products are currently in use in your department? .. 26

Q19 Which of the following ArcGIS extensions are currently in use in your department?
(1 of 2)..... 28

Q20 Which of the following ArcGIS extensions are currently in use in your department?
(2 of 2)..... 29

Q21 Which of the following ArcGIS servers are currently in use in your department? 31

Q22 Which of the following ArcGIS solutions are currently in use in your department?
..... 32

Q23 Which of the following ArcGIS app building and development tools are currently in
use in your department? 34

Q24 Which of the following ArcGIS mobile applications are currently in use in your
department?..... 35

Q25 Which of the following ArcGIS office applications are currently in use in your
department?..... 36

Q26 Please describe any other non-Esri GIS software..... 38
solutions currently in use by your department. 38

Q27 Of the software solutions currently available to you, are there any in which the
functionalities or capabilities are inadequate for your needs?..... 39

Q28 Are there any software solutions you don't have access to but wish you did? 40

Q29 How would you rate the integration of these solutions into or alongside your
organization's other business management or information technology systems? 41

Q30 Do you use mobile solutions to access, edit or create GIS data?..... 42

Q31 How would you rate the integration of GIS with your mobile devices? 43

Q32 Do you have 24/7 availability to GIS applications?..... 44

Q33 Are GIS data layers and/or software solutions used by other departments also
accessible to you?..... 45

Q34 Does your current system have daily backup procedures? 46

Q35 Do you experience any issues with network connectivity or speed? 47

Q36 Have you experienced any issues with data storage capacity? 48

Q37 Are the GIS-enabled devices available to you sufficient in maximizing your use of
GIS? 49

Q38 On a scale of 1-10, how would you rate the enthusiasm for GIS technology in the
organization?..... 50

Q39 On a scale of 1-10, how would you rate organization's commitment to growing your
abilities as a GIS User?..... 51

Q40 Does your organization provide any formal GIS training via workshops, classes or
tutorials? 52

Q41 Has your organization enabled you to attend any local, regional, or national GIS conferences or other user gatherings? 53

Q42 Does your organization have a user's group or similar body that meets on occasion to talk about and/or work with GIS? 54

Q43 Who do you turn to for GIS technical support, advice, training, education or other knowledge-based support? 55

VOICE OF THE CUSTOMER (VOC) SURVEY

The City of Irvine has realized various successes in the process of developing a Geographic Information System (GIS) program. A solid foundation and tremendous opportunity exists for Irvine to expand GIS further throughout the City and to external customers.

A variety of departments use the technology for a diverse set of needs. It is important that the customers have a venue and a mechanism to share their needs, concerns, and opinions about the technology. Many GIS implementations do not reach full adoption and some even fail altogether because the customer's voice is not heard. Therefore, it is important that the City of Irvine's GIS customers feel they have various mechanisms for being heard.



Voice of the Customer is used in business and information technology fields to describe the in-depth process of capturing a customer's expectations, preferences, and aversions. It is a market research tool to help identify needs and satisfaction so that priorities can be set to satisfy those needs. In this case, the market being researched is the market of current and prospective users and beneficiaries of the City's GIS. The Voice of the Customer is optimally heard through various ongoing feedback mechanisms to include:

- **Face-to-face interviews and discussions with users and prospective users**
- **Focus groups such as a GIS Steering Committee and GIS User's Group**
- **Customer feedback forms**

As part of the Citywide Enterprise GIS Master Planning initiative, a Voice of the Customer survey was administered as an online survey. The link was sent to all staff in the City and they were given several weeks to fill out the survey.

The results of this survey and the on-site interviews serve as two very informative mechanisms to understand the customers. The following are the questions and the results

of the online Voice of the Customer survey. Each of following includes the question itself, a synopsis of the reason for the question (intended purpose), a short summary Conclusions of the answers, charts summarizing the answers (if contextually appropriate), and the descriptive responses of the respondents (if applicable).

Questionnaire ConclusionsConclusions

The purpose of the questionnaire is to help assess the current state of GIS and help determine the next steps in creating a successful GIS roadmap for the City of Irvine. Anonymous ratings and comments were gathered on GIS needs, constraints, and opportunities. Components of the questionnaire covered the following topics:

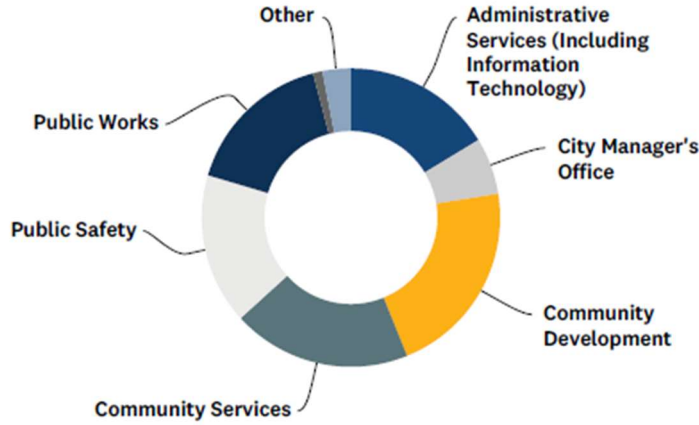
- Governance and Management
- Digital Data and Databases
- Training, Education, and Knowledge Transfer
- Procedures, Workflow, and Integration
- Software
- Infrastructure

The online survey was available to City employees from January 30, 2019 through February 19, 2019. There were 98 responses received.

The survey offered the following insights about the state of GIS at the City of Irvine.

Q1 What department do you work in?

Answered: 98 Skipped: 0



ANSWER CHOICES	RESPONSES	
Administrative Services (Including Information Technology)	16.33%	16
City Manager's Office	6.12%	6
Community Development	21.43%	21
Community Services	19.39%	19
Public Safety	16.33%	16
Public Works	16.33%	16
Transportation	1.02%	1
Other	3.06%	3
TOTAL		98

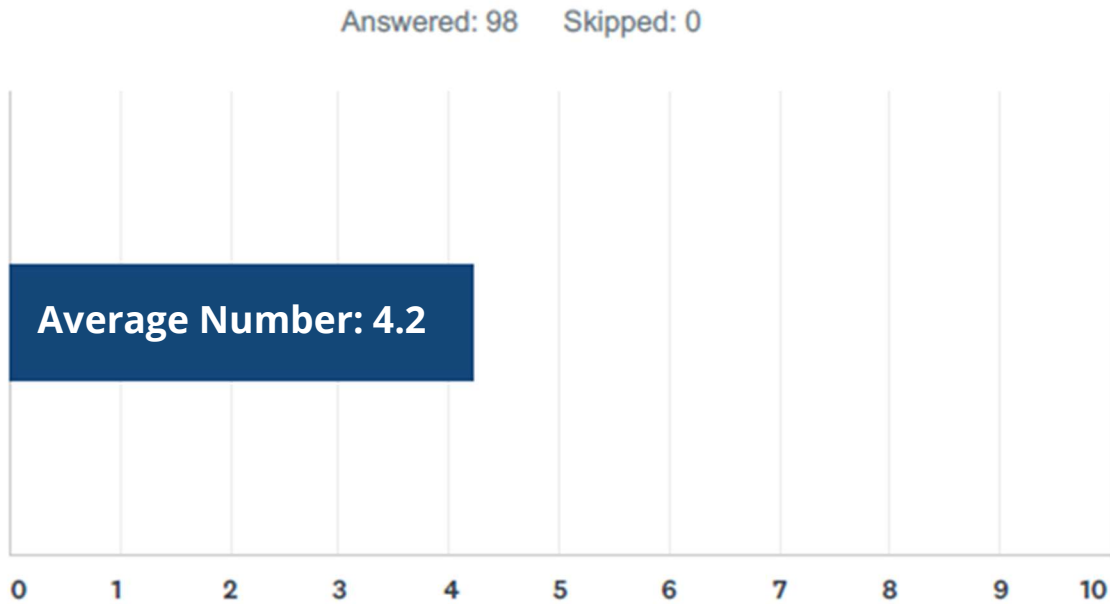
#	OTHER
1	Building and Safety
2	City Clerk
3	City Clerk's Office (Records Division)

Conclusions

The greatest number of responses came from the Community Development Department, followed closely by the Community Services Department. In all, ten departments/divisions are represented.

4 | Questionnaire Conclusions

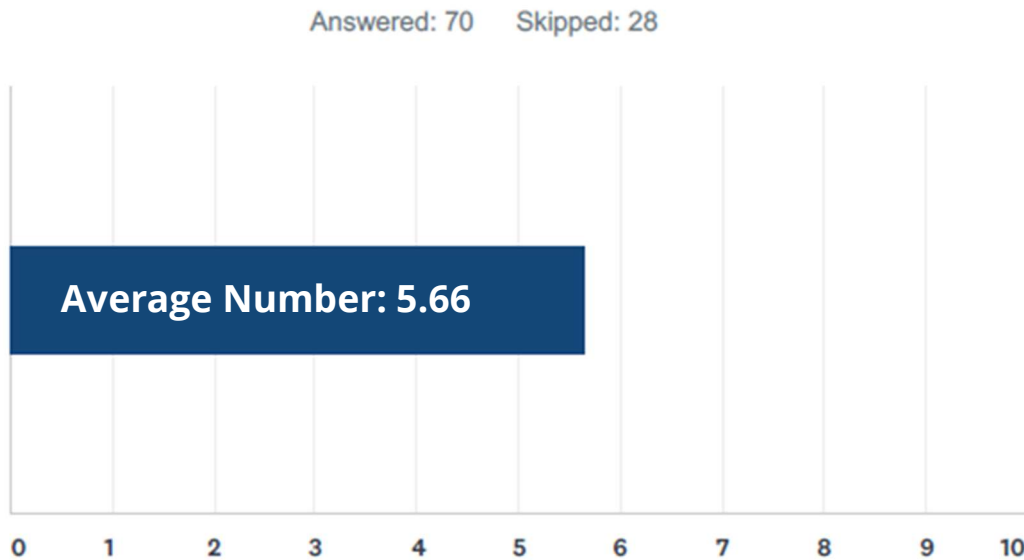
Q2 On a scale of 1-10, how would you rate your level of GIS expertise?



Conclusions

The average GIS expertise rating given by staff was 4.2. This shows that there is some experience with GIS, but there is room to educate and train additional users on its usefulness at the City.

Q3 On a scale of 1-10, how well do the current GIS solutions and services available to you support you in your role?

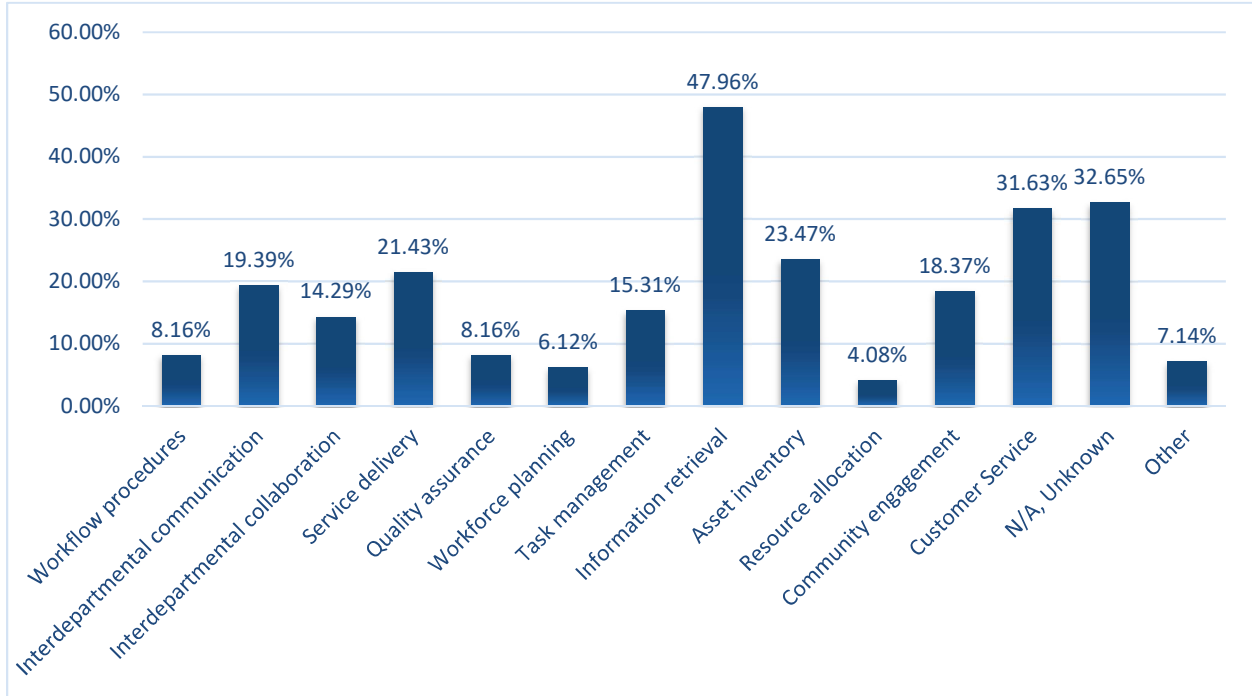


Conclusions

The staff mostly believe that the current GIS solutions support their GIS needs; however, there is some room to improve. One of the elements to consider in this question is that users do not know what they do not know. Therefore, they may think the GIS is meeting their needs but are unaware of the breadth of what GIS can do for them. Typically, the users believe that GIS is only a digital map and do not fully appreciate how GIS can assist them with their job. There are opportunities for additional tools and integration with key enterprise IT systems. The average rating for this question was 5.7.

Q4 In which areas have GIS helped you in your role or improved processes for you or your organization?

Answered: 98 Skipped: 0



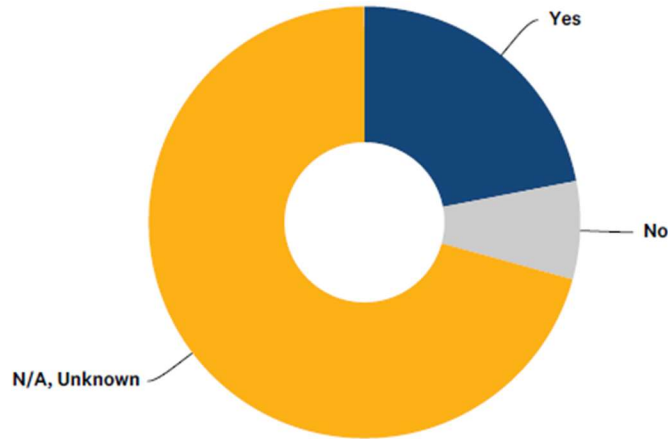
#	OTHER
1	Call assistance and area knowledge of enforcement areas and accepted streets in new developments.
2	Making and printing maps
3	In it's current state, not much. In other jurisdictions, lots
4	Don't currently use but would be helpful
5	Transporation Planning - Environ, Design, ROW
6	geocoding industrial and commercial facilities
7	Mapping - parcel ownership

Conclusions

Information Retrieval and Customer Service ranked the highest. This indicates that users are mainly using GIS for viewing data and answering questions. It would be expected that through a systematic education program that the City will see the numbers increase in all categories. Users should start to understand the breadth of what GIS can do for them beyond the mundane. This is a key growth metric over the next five years and the City of Irvine should ensure that education opportunities are frequent so that users can understand what GIS can do for them.

Q5 Does your organization have a master data list containing a full inventory of GIS data sets and map layers as well as information on the storage and upkeep of each?

Answered: 82 Skipped: 16



ANSWER CHOICES	RESPONSES	
Yes	21.95%	18
No	7.32%	6
N/A, Unknown	70.73%	58
TOTAL		82

#	TELL US MORE:
1	Don't know.
2	i think so
3	If so, I am unaware.
4	I know we have layers, but I'm not sure about the storage/upkeep of them.
5	Yes, in general, but Great Pak information is slow getting onto the system
6	This is maintained by the city GIS unit, we just access these layers. They have given us full access.
7	We still need to obtain a full inventory of various infrastructure
8	Depends on the department, PW has inventory but little upkeep information
9	Not aware of it, if it does.
10	GIS maintains this data

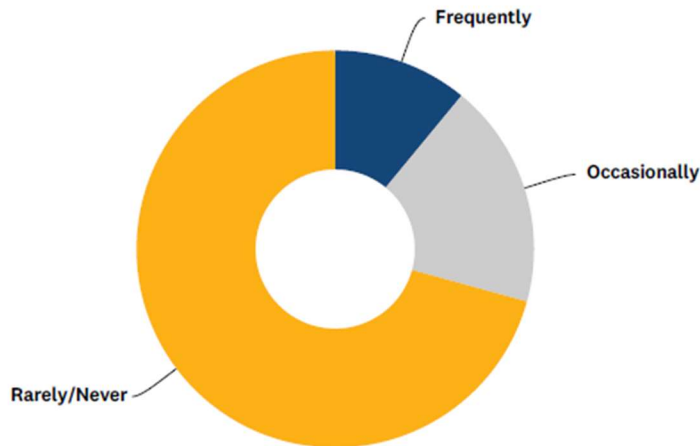
8 | Questionnaire Conclusions

Conclusions

Most users are unaware of a master data list (MDL). One of the most important aspects of an enterprise-wide GIS is to have an accessible and understandable MDL. An MDL is a document/s (hard copy and digital) that succinctly list all of the pertinent geospatial data layers. Two versions of this document are needed at a minimum. The first, is a more in-depth holistic document that lists every layer in an organized fashion. This should be a comprehensive document maintained by key members of Irvine’s geospatial data team. However, a customer friendly version of this MDL should be made available to the users. The focus for this MDL is a categorized list of key data layers in a checklist format so that users can readily let the core GIS team know what data they need to consume via their various GIS portals.

Q6 How often do you create new or modify existing GIS data or metadata?

Answered: 82 Skipped: 16



ANSWER CHOICES	RESPONSES	
Frequently	10.98%	9
Occasionally	18.29%	15
Rarely/Never	70.73%	58
TOTAL		82

#	TELL US MORE:
1	update with map rolls, hopefully every 1-2 years
2	unknown
3	n/a
4	not sure
5	Working with GIS staff on updating GP layer
6	I require land use and storm drain data to conduct analysis for stormwater compliance related tasks
7	We create new crime layers frequently.
8	Unsure of frequency
9	Occasionally now that the position was filled and I no longer need to fill in
10	Everytime a tract map is submitted.
11	Occasionally make maps and layers for senior staff
12	I don't modify existing data from GIS department, but frequently create and modify my own layers in in my own mapping projects where basemap and a few other layers have been previously provided by the GIS department
13	I modify my own layers, not one's on the City server.
14	We are awaiting the purchase on an ESRI integration with our OnBase ECM to streamline this process

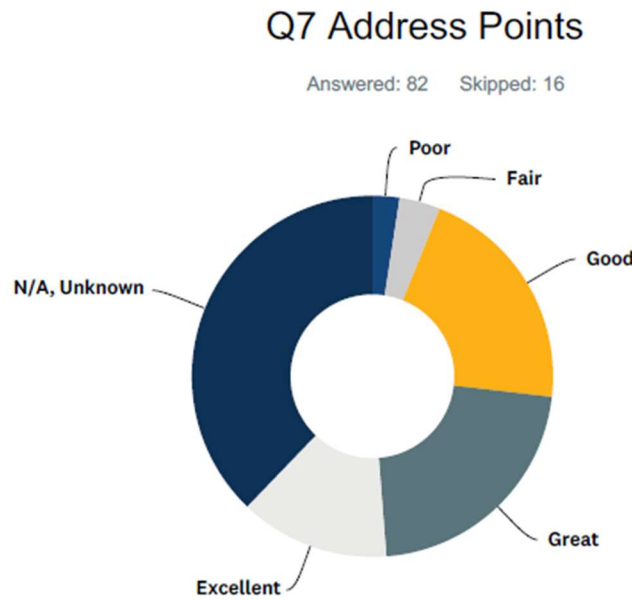
10 | Questionnaire Conclusions

Conclusions

Most of the respondents may not be responsible for data maintenance or metadata. Metadata describes the collective characteristics of data. In short, metadata are data about data. Metadata details how, when, and where data has created or collected its documents scale, accuracy, resolution and other properties. Irvine has basic information about the data that can be considered a start to metadata, but has not mandated data custodian groups to update and maintain metadata. A plan to maintain basic elements of metadata is important for any organization. As was the case for the MDL, the metadata must be maintained in an easy-to-use format so that any user can readily access it and understand it. Additionally, it must be in such a format that it is easy to maintain. A key custodian needs to be identified in the central GIS team for instituting, training, and ensuring that the metadata is created and maintained.

Please rate the accuracy, reliability and completeness of the following critical data layers:

Q7 Address Points



POOR	FAIR	GOOD	GREAT	EXCELLENT	N/A, UNKNOWN	TOTAL	WEIGHTED AVERAGE
2.44%	3.66%	20.73%	21.95%	13.41%	37.80%	82	3.65
2	3	17	18	11	31		

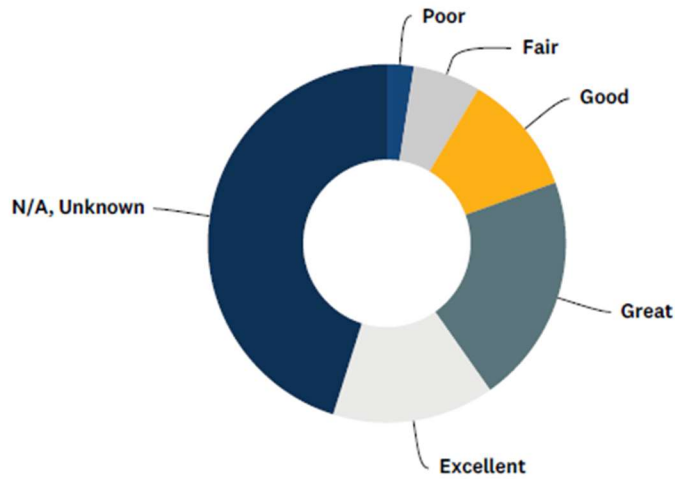
Conclusions

Most respondents felt that the address point data is excellent to good. However, some respondents did not seem aware of the layer or its quality. The address points will be examined as part of this study. A holistic education plan should be instituted to ensure that the organization understands the key base layers and their importance.

Q8 Parcels

Q8 Parcels

Answered: 82 Skipped: 16



POOR	FAIR	GOOD	GREAT	EXCELLENT	N/A, UNKNOWN	TOTAL	WEIGHTED AVERAGE
2.44%	6.10%	10.98%	20.73%	14.63%	45.12%	82	3.71
2	5	9	17	12	37		

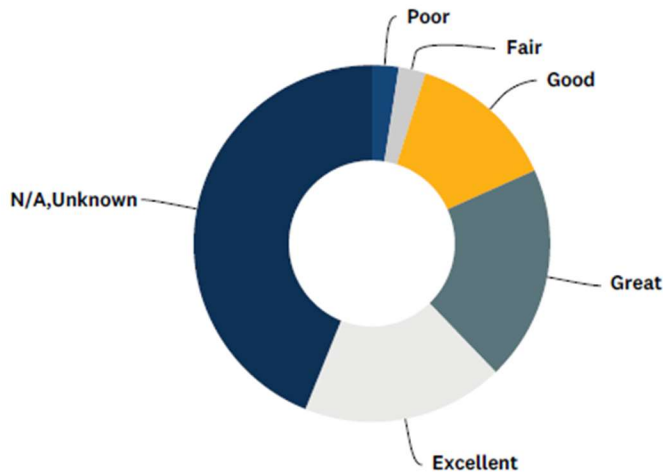
Conclusions

Of those who rated this dataset, most respondents scored the parcel data quality as excellent, great or good. However, some respondents did not seem aware of the layer or its quality. The parcels will be examined as part of this study. A holistic education plan should be instituted to ensure that the organization understands the key base layers and their importance.

Q9 Street Centerlines

Q9 Street Centerlines

Answered: 82 Skipped: 16



POOR	FAIR	GOOD	GREAT	EXCELLENT	N/A,UNKNOWN	TOTAL	WEIGHTED AVERAGE
2.44%	2.44%	13.41%	19.51%	18.29%	43.90%	82	3.87
2	2	11	16	15	36		

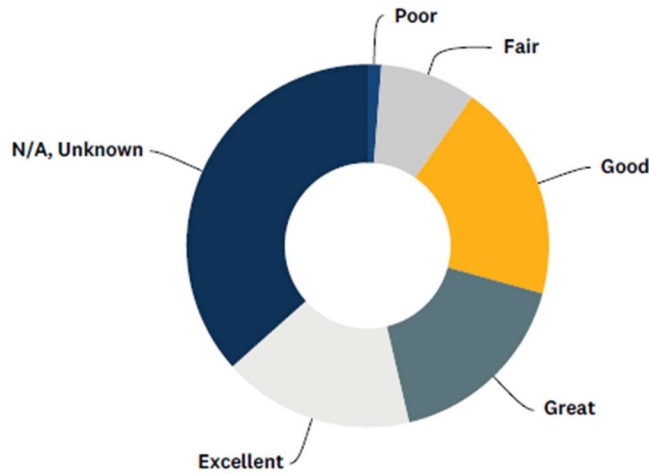
Conclusions

Of those who rated this dataset, most respondents scored the street centerline data quality as excellent to good, meaning there is confidence in this dataset. However, more than half of the respondents did not seem aware of the layer or its quality. The street centerlines will be examined as part of this study. A holistic education plan should be instituted to ensure that the organization understands the key base layers and their importance.

Q10 Aerial Photography

Q10 Aerial Photography

Answered: 82 Skipped: 16



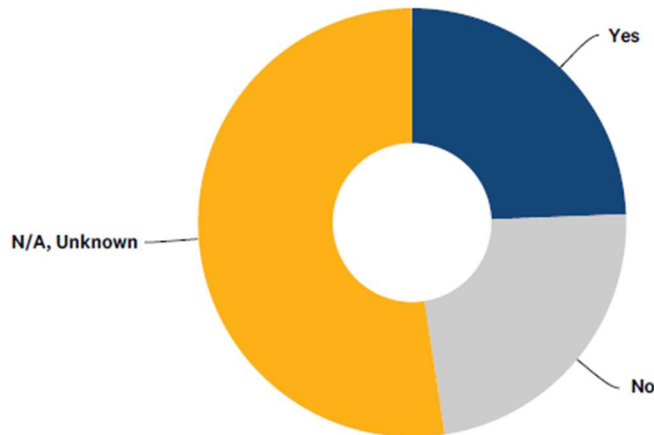
POOR	FAIR	GOOD	GREAT	EXCELLENT	N/A, UNKNOWN	TOTAL	WEIGHTED AVERAGE
1.22%	8.54%	19.51%	17.07%	17.07%	36.59%	82	3.63
1	7	16	14	14	30		

Conclusions

Of those who rated this dataset, most respondents scored the aerial photography data quality as good to excellent. The aerial photography will be examined as part of this study. A holistic education plan should be instituted to ensure that the organization understands the key base layers and their importance.

Q11 Of the data sets and map layers you have used, are there any that seem inaccurate or incomplete?

Answered: 82 Skipped: 16



ANSWER CHOICES	RESPONSES	
Yes	24.39%	20
No	23.17%	19
N/A, Unknown	52.44%	43
TOTAL		82

#	TELL US MORE:
1	Not frequently updated, when compared to Google Maps or other mapping software
2	City catch basin locations (not accurate) and storm drain pipeline network (incomplete). Existing layer does not easily differentiate between City-owned/maintained versus HOA-owned storm drains. Bus stop layer may show planned versus actual operating bus stops. Would like layer that can differentiate whether it is an OCTA vs iShuttle transit stop.
3	Great Park information is slow to get onto the system
4	New addresses are only entered after the city approves them, but there are often crime at these locations before that occurs. Our dispatchers have trouble occasionally locating these new addresses.
5	Storm drain infrastructure needs to be updated/finalized.
6	Storm structures, signs, bridges
7	Orange County Great Park layer
8	treatment control unit information
9	Tentative Tract Maps
10	Storm drain inventory. UCI address, Onbase integration for document retrieval, current road detour/closure, housing development by product
11	Some street names are abbreviated making searching difficult (e.g. Oak Canyon is Oak CYN)
12	Not aware of any inaccurate layers

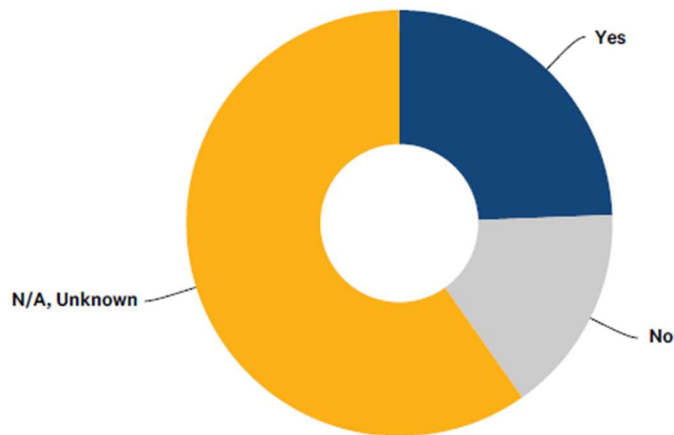
13	Great Park Aerial Shots. It would be great to get the aerial images, addresses and street names updated more frequently for OCGP.
14	Incomplete, but I do not believe this is due to GIS department oversight as much as to the ever changing city and the work that it takes to continually keep this information updated.
15	The city boundary data
16	Parcel mapping is totally inaccurate

Conclusions

About one quarter of respondents deem some data layers as inaccurate or incomplete. The reality and perception of the veracity of the various data layers is critical for a successful enterprise-wide GIS. Users must be confident that the data they are using is accurate and updated. If not, they need to know the insufficiencies of the data. Education and metadata are key to this. Additionally, work flows and standard operating procedures need to be examined to ensure that critical data sets are being maintained in a manner that is required by the user base. Those that have life and safety implications, such as address points, need to be given the utmost priority.

Q12 Are there any datasets or map layers that would be useful to you but are currently inaccessible or non-existent?

Answered: 82 Skipped: 16



ANSWER CHOICES	RESPONSES	
Yes	24.39%	20
No	15.85%	13
N/A, Unknown	59.76%	49
TOTAL		82

#	TELL US MORE:
1	Because the grading team is spread out via areas, creating a map layer for other inspectors they can pull up either in Eden map or Google Map may be helpful. If the other teams operate this way, doing the same for them might also be helpful.
2	there are missing storm drain inlet and piping networks not in GIS
3	Great Park
4	I would like traffic/street congestion information as a layer.
5	Parking lots, sidewalk/hardscape, traffic signal inventory
6	Utilities
7	WQMP project boundary line
8	Street median, side walk, parkway.
9	A layer for Conflict of Interest (Councilmembers/Commissioners)
10	Not sure
11	A detailed layer containing City assests including buildings, other facilities, trail bridges/tunnels, outdoor lighting, site furnishings, flag poles, shade structures, playgrounds, fountains, pumpstations, water meters, gas meters, electrical meters, heavy mechanical, HVAC, sewer cleanouts, water valves, solar locations, fence lines, ADA automatic door locations and attributes. IoT like playground, trail, park and sportcourt, activity sensors with high/no use alarms!
12	See #11 - Improve OCGP (area 51) addresses & aerials more frequently.

18 | Questionnaire ConclusionsConclusions

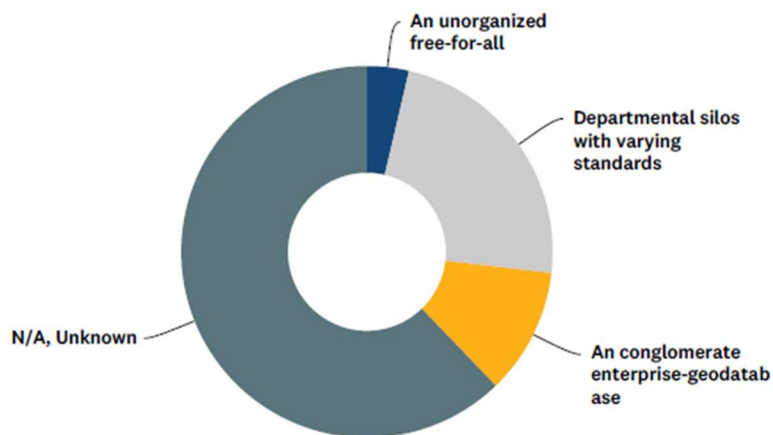
13	I have some ideas of datasets and maplayers that I might find useful at times or that I could foresee being useful in an emergency situation, but I have no idea if they exist or not.
14	Cameras
15	city easements,
16	I would like to see more democratization of data starting with the publication of datasets from studies conducted for the City such as traffic studies, citizen surveys, etc.

Conclusions

As identified in the report above, some users are not aware of what data is available and some users have requested data layers that do not exist, such as Parking, Traffic and Easements. Efforts need to be made to develop and distribute a master data list and create new data layers based on priority. The lack of awareness of the GIS throughout the organization is pervasive and is being identified throughout this questionnaire. A pervasive education program must be instituted so that Irvine can begin to get a return on investment from the wealth of existing data.

Q13 How would you describe the GIS database structure at your organization?

Answered: 82 Skipped: 16



ANSWER CHOICES	RESPONSES	
An unorganized free-for-all	3.66%	3
Departmental silos with varying standards	23.17%	19
An conglomerate enterprise-geodatabase	10.98%	9
N/A, Unknown	62.20%	51
TOTAL		82

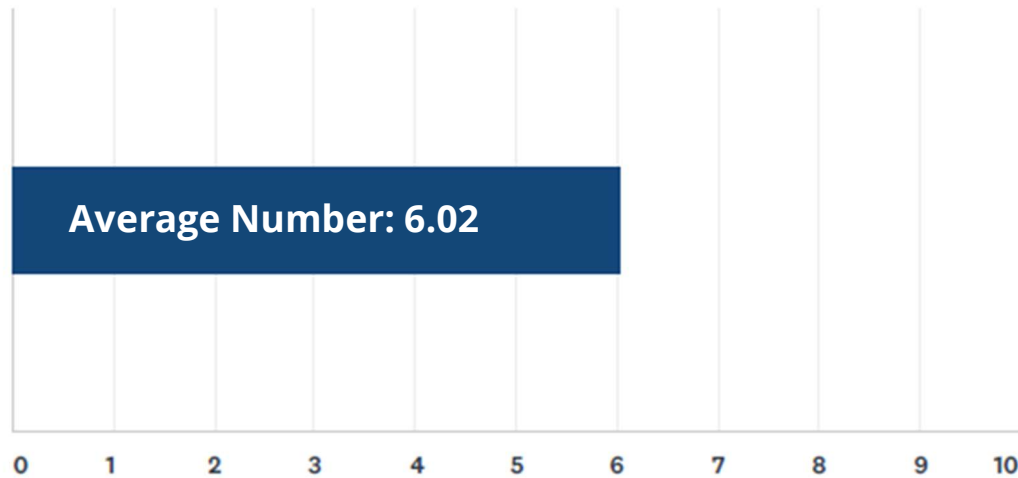
#	TELL US MORE:
1	We need an enterprise system
2	I think more communication/coordination is a good thing.
3	There are centralized dataset and departmental specific dataset
4	Various people have access at different levels
5	I think there are huge opportunities for GIS data set use across the City of Irvine. I love the Chicago data portal: https://data.cityofchicago.org/
6	Within PW

Conclusions

There is a mix of respondents who see the GIS database as a centralized repository, and those who see departmental silos with varying standards. This speaks to the need to ensure all enterprise data is stored within the enterprise geodatabase and that all pertinent staff store data centrally. Furthermore, data standards and data creation procedures should be developed and employed throughout the City to ensure all data is created to in a standardized fashion.

Q14 On a scale of 1-10, how easy is it to find GIS datasets or map layers you need to fulfill your job duties?

Answered: 56 Skipped: 42

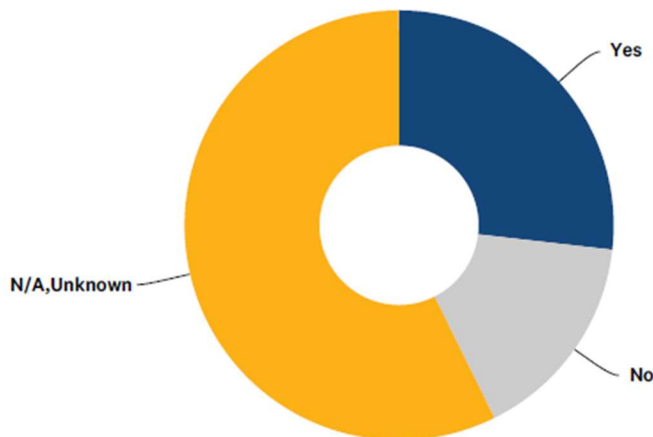


Conclusions

The number of respondents is decreasing in these latter questions. Again, many people do not fully realize the breadth of what GIS can do for the City. Therefore, the results of this question may not be indicative of an informed user base. With further education and through the process of this plan, users may realize that they have many datasets that do not currently exist.

Q15 Can you think of an instance where data is being stored and maintained by separate individuals or departments, a situation which could result in duplicated and/or conflicting information across separate mediums?

Answered: 82 Skipped: 16



ANSWER CHOICES	RESPONSES	
Yes	26.83%	22
No	15.85%	13
N/A, Unknown	57.32%	47
TOTAL		82

#	TELL US MORE:
1	but sounds probable
2	GIS vs CDB
3	Public Works center line, storm structures
4	I'm unsure of current status; but I believe there were instances where separate departments were duplicating efforts.
5	Street layers in different databases do not update at the same time and have caused confusion
6	park size, CD databases have conflicts with addresses and parcels
7	Citywide Database Maintenance versus GIS Maintenance
8	HOA contacts
9	I made layers that were saved on my own computer only
10	Sire, Lucity, google, the budget, hunders of spreadsheets throught the org
11	Yes - particularly when it comes to data visualization. One application I think the City would benefit from utilizing would be Tableau dashboards - that can geocode facility maintenance tickets to population shifts.

22 | Questionnaire ConclusionsConclusions

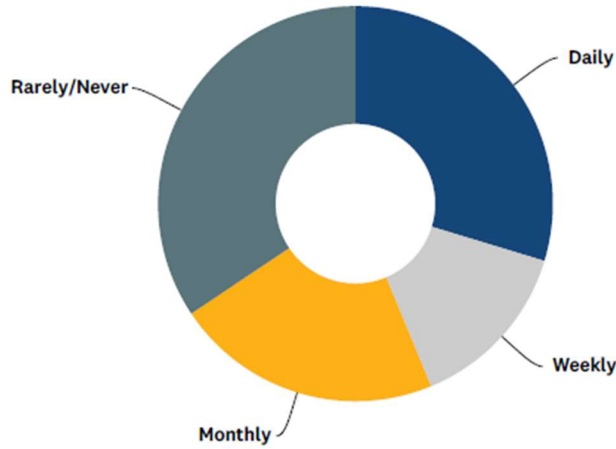
12	I complete my own GIS work for the GP
13	Records stores and maintains data and documents linked to existing GIS sites

Conclusions

As mentioned previously, there are some data layers that are housed outside of the enterprise database that should be migrated to a central location that is accessible by other staff across the City. As the GIS matures and this plan is instituted, a priority should be 100% centralization of key datasets. However, some storage of local users' specific datasets is always expected. If the data has benefit to others and may be needed in the future it should be stored in the central geodatabase.

Q16 On average, how often are you using GIS?

Answered: 64 Skipped: 34



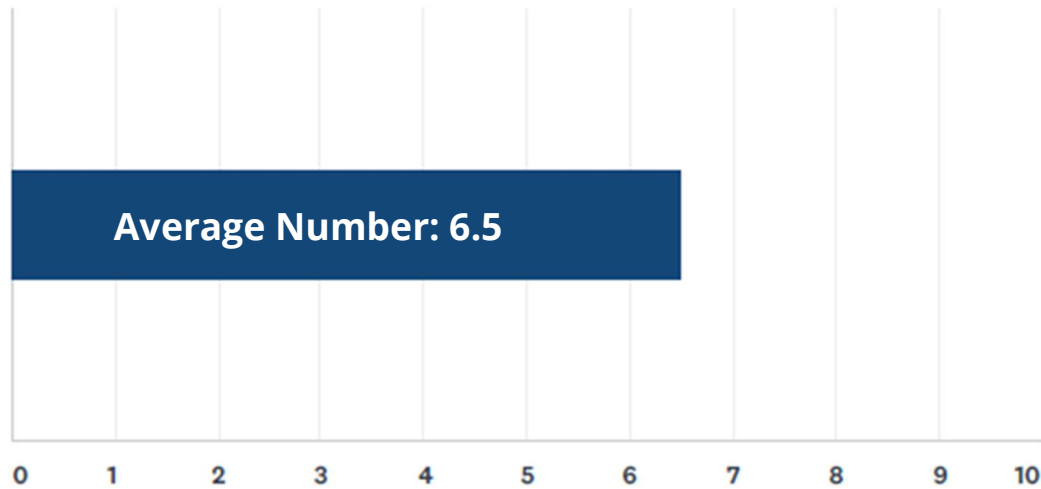
ANSWER CHOICES	RESPONSES	
Daily	29.69%	19
Weekly	14.06%	9
Monthly	21.88%	14
Rarely/Never	34.38%	22
TOTAL		64

Conclusions

Overall this question reveals a lack of enterprise-wide usage or perhaps a user base that is unaware that they are using GIS. For the most part, it should be expected that, a) everyone uses GIS at least monthly b) users understand the value of the GIS and how it benefits them. This plan will help with promoting GIS and recommendations will be made to ensure that the organization has knowledge of GIS and the tools/training to access GIS.

Q17 How would you rate your organization's commitment to making the most up-to-date GIS solutions available to you?

Answered: 44 Skipped: 54

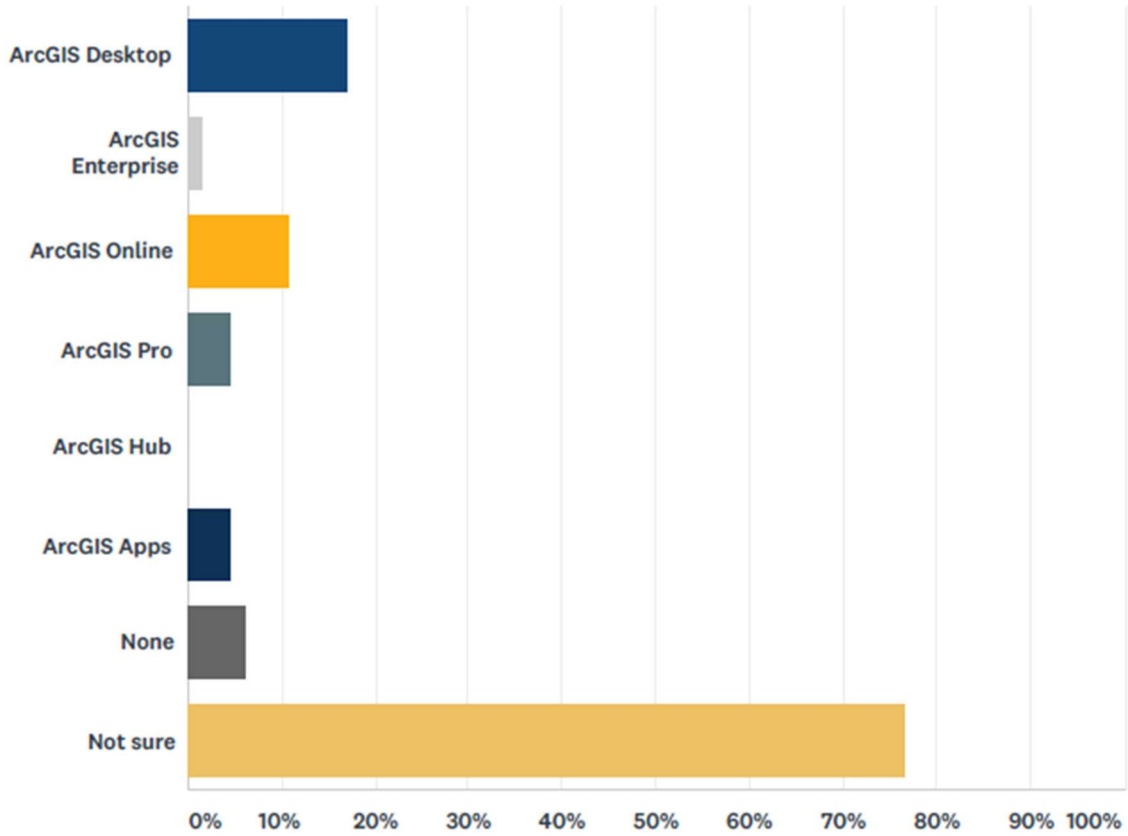


Conclusions

Only 44 staff answered this question and it would be expected that they are the most knowledgeable of GIS in the organization. It is expected that the respondents do not fully know what GIS tools are available through the modern GIS toolset. There will be a big opportunity for growth using the plethora of Esri tools that are available to the City.

Q18 Which of the following Esri products are currently in use in your department?

Answered: 64 Skipped: 34



ANSWER CHOICES	RESPONSES	
ArcGIS Desktop	17.19%	11
ArcGIS Enterprise	1.56%	1
ArcGIS Online	10.94%	7
ArcGIS Pro	4.69%	3
ArcGIS Hub	0.00%	0
ArcGIS Apps	4.69%	3
None	6.25%	4
Not sure	76.56%	49
Total Respondents: 64		

#	IF YOU ANSWERED "ARCGIS DESKTOP," PLEASE TELL US WHICH VERSION IF POSSIBLE (I.E. BASIC, ADVANCED, ETC.):
1	dont know
2	10.2.2
3	Basic
4	10.2.2
5	Basic 10.2.2
6	10.2

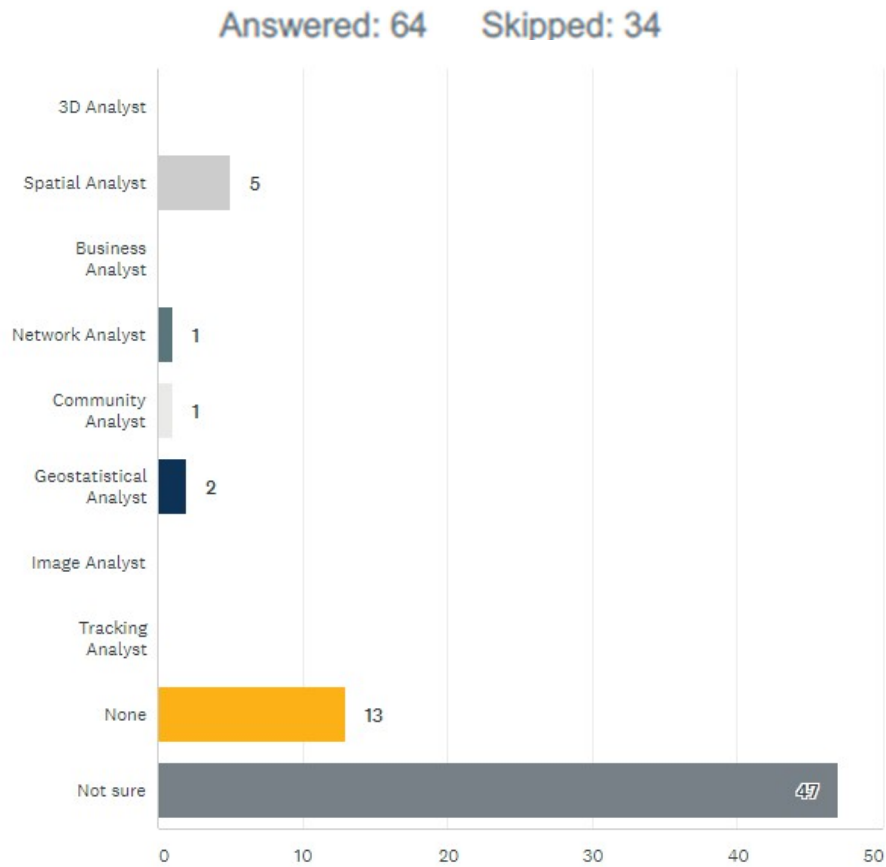
#	IF YOU ANSWERED "ARCGIS DESKTOP," PLEASE TELL US WHICH VERSION IF POSSIBLE (I.E. BASIC, ADVANCED, ETC.):
1	10.6.1
2	unknown
3	We have Basic and Advanced
4	Advanced; 10.6.1

#	IF YOU ANSWERED "ARCGIS DESKTOP," PLEASE TELL US WHICH VERSION IF POSSIBLE (I.E. BASIC, ADVANCED, ETC.):
1	10.6.1
2	unknown
3	We have Basic and Advanced
4	Advanced; 10.6.1
5	Not sure
6	10.6.1
7	10.6.1

Conclusions

Of those who responded, ArcGIS Desktop is the most heavily used, followed by ArcGIS Online. The ArcGIS Desktop version is the latest available and it is consistent across the departments. Respondents who answered may not be using a core Esri product; instead, they may be using an intranet browser application.

Q19 Which of the following ArcGIS extensions are currently in use in your department? (1 of 2)

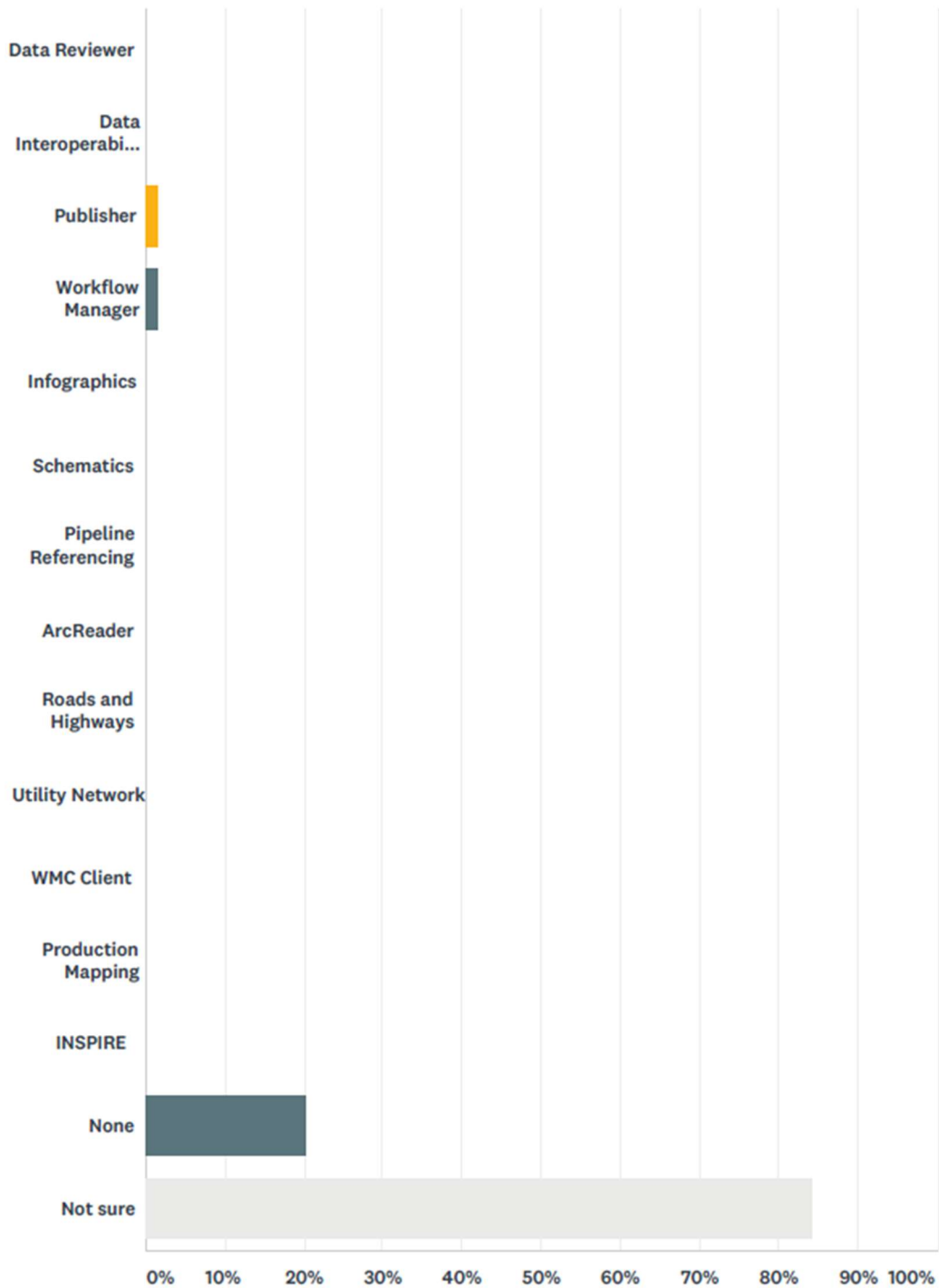


See Conclusions following Part 2.

ANSWER CHOICES	RESPONSES	
3D Analyst	0.00%	0
Spatial Analyst	7.81%	5
Business Analyst	0.00%	0
Network Analyst	1.56%	1
Community Analyst	1.56%	1
Geostatistical Analyst	3.13%	2
Image Analyst	0.00%	0
Tracking Analyst	0.00%	0
None	20.31%	13
Not sure	73.44%	47
Total Respondents: 64		

Q20 Which of the following ArcGIS extensions are currently in use in your department? (2 of 2)

Answered: 64 Skipped: 34

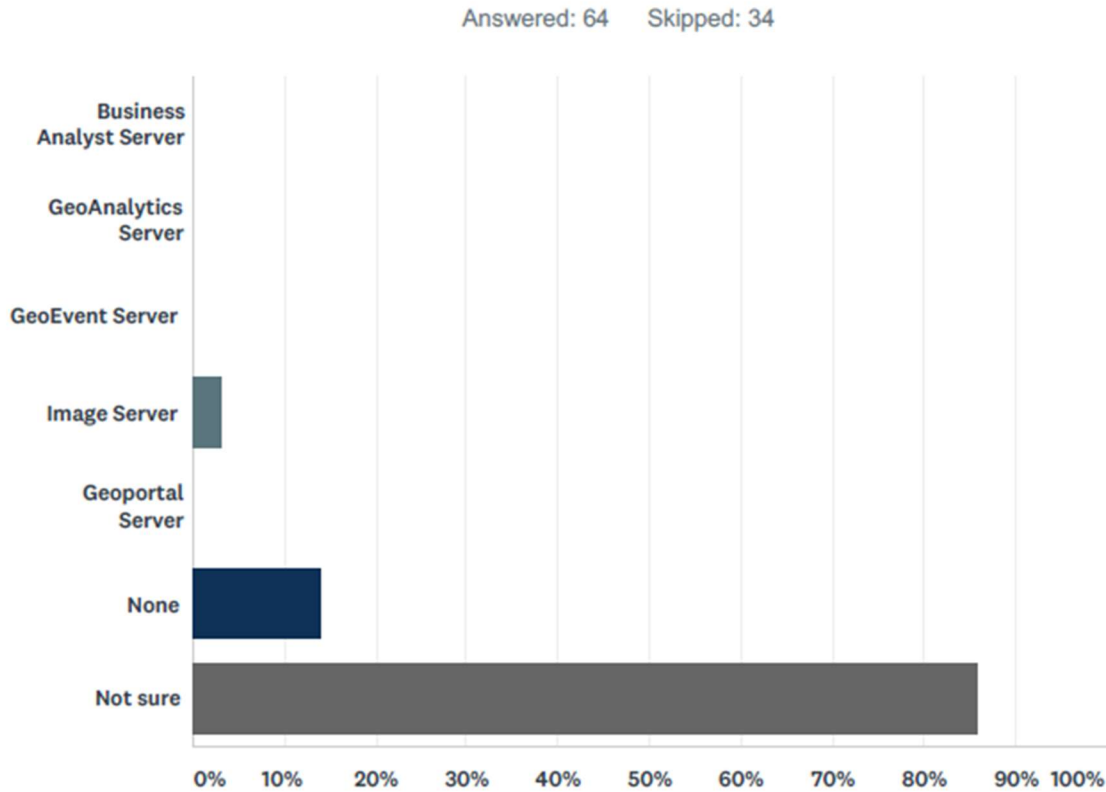


ANSWER CHOICES	RESPONSES	
Data Reviewer	0.00%	0
Data Interoperability	0.00%	0
Publisher	1.56%	1
Workflow Manager	1.56%	1
Infographics	0.00%	0
Schematics	0.00%	0
Pipeline Referencing	0.00%	0
ArcReader	0.00%	0
Roads and Highways	0.00%	0
Utility Network	0.00%	0
WMC Client	0.00%	0
Production Mapping	0.00%	0
INSPIRE	0.00%	0
None	20.31%	13
Not sure	84.38%	54
Total Respondents: 64		

Conclusions

Extensions are potentially under-utilized. Users should be educated on extensions available from Esri. This plan will identify opportunities for using these specialized Esri tools. Not all of them will be needed any many of them will only be used by specialized GIS experts within the organization.

Q21 Which of the following ArcGIS servers are currently in use in your department?



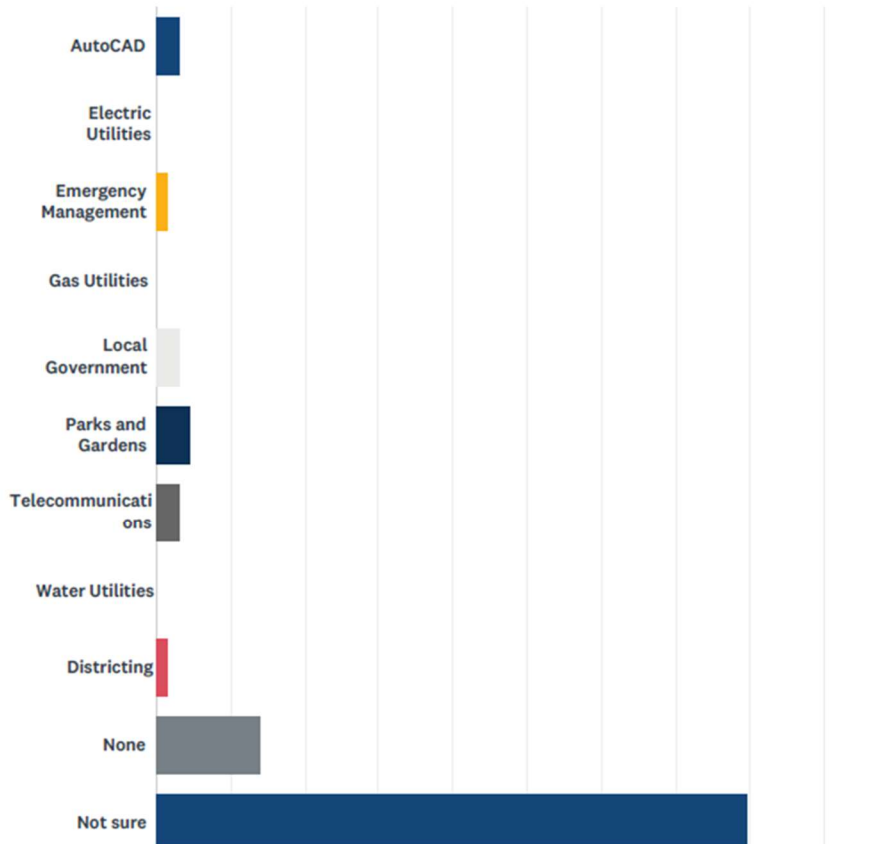
ANSWER CHOICES	RESPONSES	
Business Analyst Server	0.00%	0
GeoAnalytics Server	0.00%	0
GeoEvent Server	0.00%	0
Image Server	3.13%	2
Geoportal Server	0.00%	0
None	14.06%	9
Not sure	85.94%	55
Total Respondents: 64		

Conclusions

Image server is the only identified specialized server extensions. It would be expected that most staff taking the survey are unaware of these extensions. These extensions should be fully understood by the core GIS staff and used where appropriate.

Q22 Which of the following ArcGIS solutions are currently in use in your department?

Answered: 64 Skipped: 34



ANSWER CHOICES	RESPONSES	
AutoCAD	3.13%	2
Electric Utilities	0.00%	0
Emergency Management	1.56%	1
Gas Utilities	0.00%	0
Local Government	3.13%	2
Parks and Gardens	4.69%	3
Telecommunications	3.13%	2
Water Utilities	0.00%	0
Districting	1.56%	1
None	14.06%	9
Not sure	79.69%	51
Total Respondents: 64		

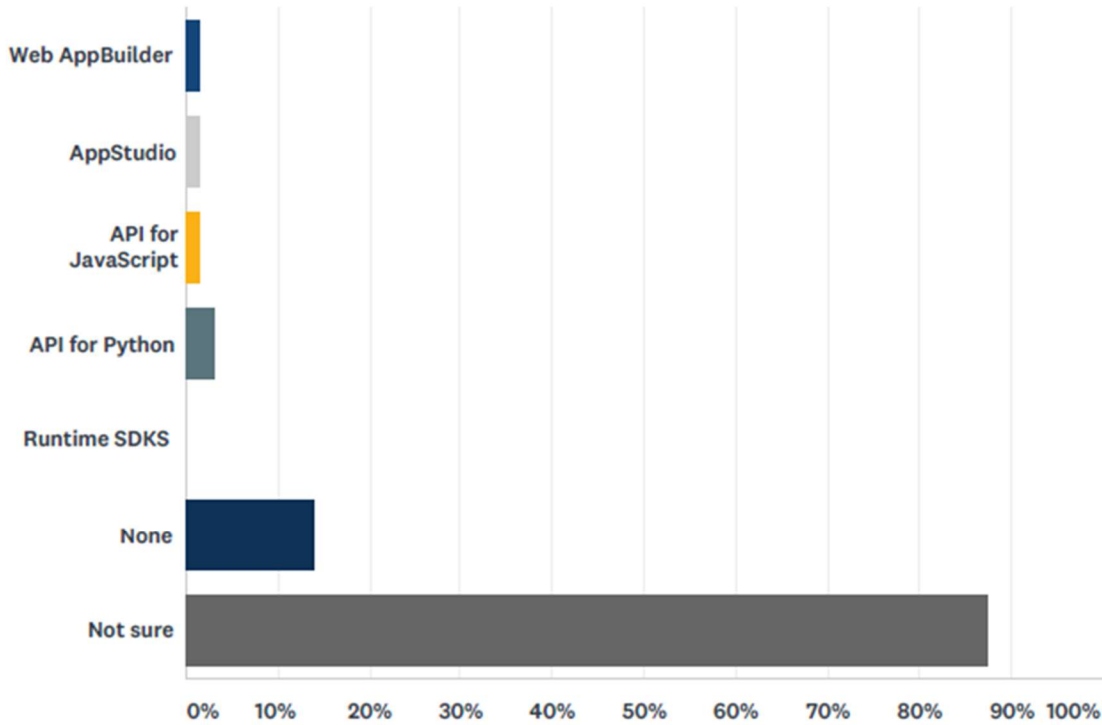
32 | Questionnaire Conclusions

Conclusions

Some users believe they are accessing specialized geospatial solutions. However, this may just be a case of them using Esri software for that purpose without specialized Esri software. Esri and Esri partners have begun to combine specific technologies to meet the needs for specific departments. It should be expected that this trend will continue and that focused functional packages will be used by various users and departments.

Q23 Which of the following ArcGIS app building and development tools are currently in use in your department?

Answered: 64 Skipped: 34



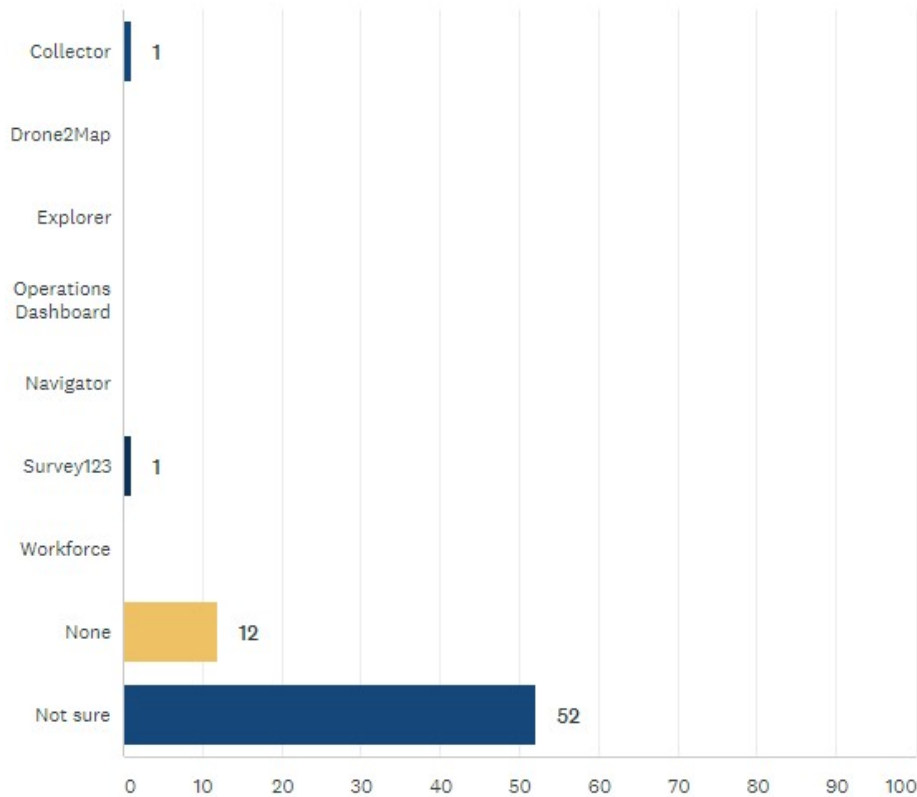
ANSWER CHOICES	RESPONSES
Web AppBuilder	1.56% 1
AppStudio	1.56% 1
API for JavaScript	1.56% 1
API for Python	3.13% 2
Runtime SDKS	0.00% 0
None	14.06% 9
Not sure	87.50% 56
Total Respondents: 64	

Conclusions

A mix of ArcGIS development tools are being used by the core GIS team. These are very specialized tools for automation. The use of these tools will increase as more users are engaged in GIS and need automation tools from the central GIS team.

Q24 Which of the following ArcGIS mobile applications are currently in use in your department?

Answered: 64 Skipped: 34

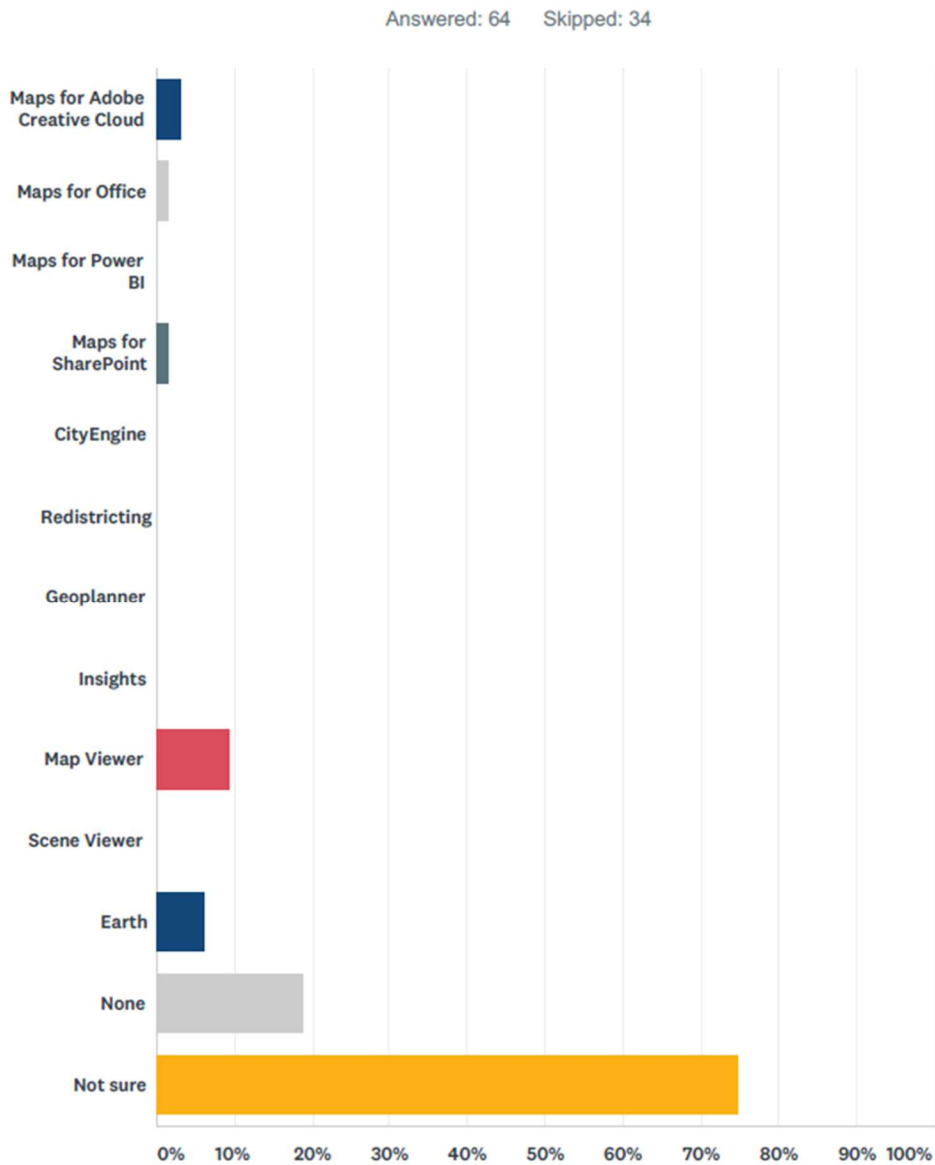


ANSWER CHOICES	RESPONSES	
Collector	1.56%	1
Drone2Map	0.00%	0
Explorer	0.00%	0
Operations Dashboard	0.00%	0
Navigator	0.00%	0
Survey123	1.56%	1
Workforce	0.00%	0
None	18.75%	12
Not sure	81.25%	52
Total Respondents: 64		

Conclusions

Overall the use of mobile tools is limited at Irvine. This is a large growth area for the City in the future.

Q25 Which of the following ArcGIS office applications are currently in use in your department?



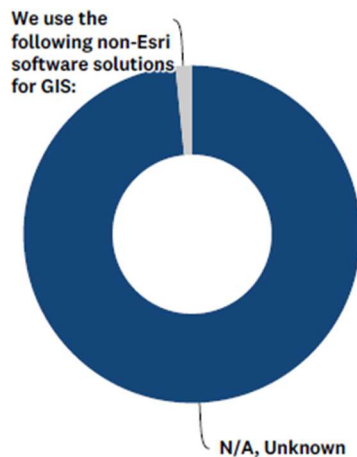
ANSWER CHOICES	RESPONSES	
Maps for Adobe Creative Cloud	3.13%	2
Maps for Office	1.56%	1
Maps for Power BI	0.00%	0
Maps for SharePoint	1.56%	1
CityEngine	0.00%	0
Redistricting	0.00%	0
Geoplanner	0.00%	0
Insights	0.00%	0
Map Viewer	9.38%	6
Scene Viewer	0.00%	0
Earth	6.25%	4
None	18.75%	12
Not sure	75.00%	48
Total Respondents: 64		

Conclusions

Only a few of the ArcGIS Office apps are being leveraged at this time. There is an opportunity to further deploy these across the departments. This plan will identify the best tools depending on the needs of the users.

Q26 Please describe any other non-Esri GIS software solutions currently in use by your department.

Answered: 64 Skipped: 34



ANSWER CHOICES	RESPONSES	
N/A, Unknown	98.44%	63
We use the following non-Esri software solutions for GIS:	1.56%	1
TOTAL		64

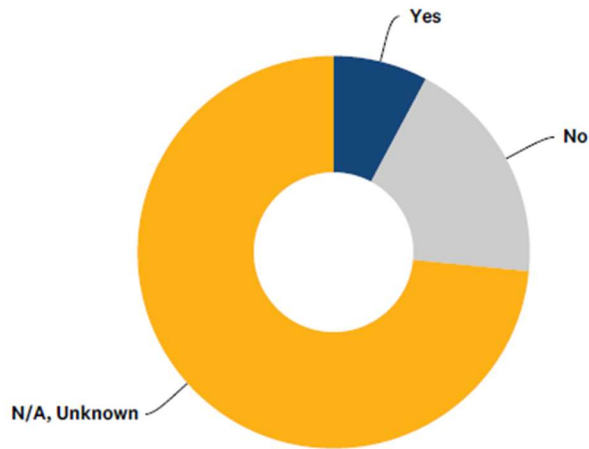
#	WE USE THE FOLLOWING NON-ESRI SOFTWARE SOLUTIONS FOR GIS:	DATE
1	Google Maps	1/30/2019 4:35 PM

Conclusions

The response of only one use of Google Maps shows very little use of non-Esri GIS solutions. This probably speaks to the lack of understanding of what GIS actually is and the tools that are current available or used. For example, Google Maps or Google Earth is probably used by many of the respondents but they may not understand that these are GIS tools.

Q27 Of the software solutions currently available to you, are there any in which the functionalities or capabilities are inadequate for your needs?

Answered: 64 Skipped: 34



ANSWER CHOICES	RESPONSES	
Yes	7.81%	5
No	18.75%	12
N/A, Unknown	73.44%	47
TOTAL		64

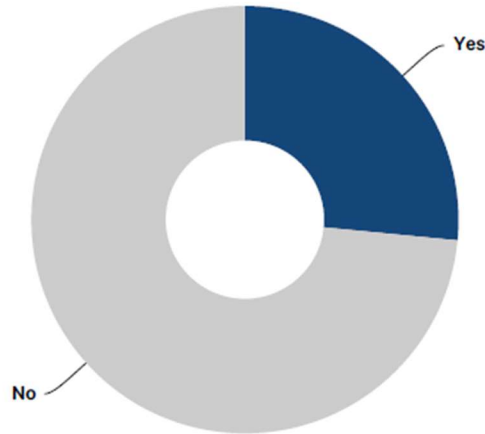
#	TELL US MORE:
1	would like to be able to more easily draw simple future locations of amenities on GIS maps and print them out and save them
2	Most of them...

Conclusions

The lack of response is indicative of underuse of GIS at the City and/or lack of education about what GIS can do for the users. As the use of GIS grows, it should be expected that users will begin to demand more functionality. The core GIS team will need to understand that some users may become more advanced and will need to be provisioned with more advanced GIS tools.

Q28 Are there any software solutions you don't have access to but wish you did?

Answered: 64 Skipped: 34



ANSWER CHOICES	RESPONSES	
Yes	26.56%	17
No	73.44%	47
TOTAL		64

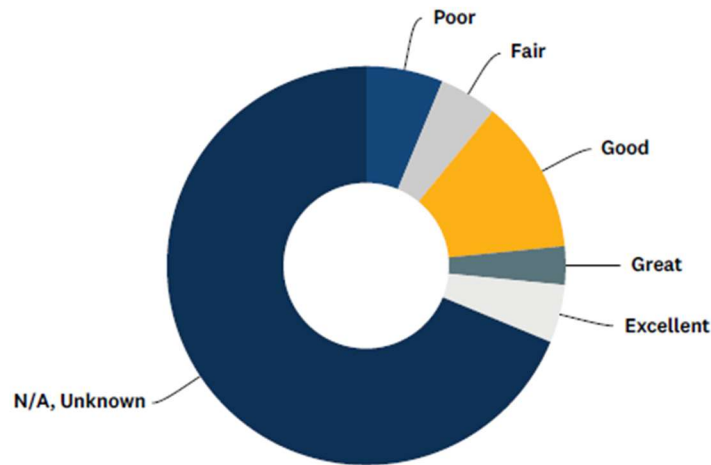
#	TELL US MORE:
1	n/a
2	don't know
3	At the police department, I'd like to see us have everyone have access to Portal
4	Any GIS functions that would assist us
5	Would like to be able to create more with the system
6	Not sure
7	Collector for emergency windshield survey
8	GeoEvent Server
9	Would like to use GIS for site-mapping for events. For measurements of sites and for plotting event layouts.
10	Trimble Pathfinder
11	Functional budget systems, accurate mapping systems
12	ArcGIS applications

Conclusions

There is a need to educate users on the tools that are available at the City now and how to use them. There is also a need to educate users on what Esri solutions are available, so they can better understand what the options are. Several requests for tools have been recorded and will be considered as part of this plan.

Q29 How would you rate the integration of these solutions into or alongside your organization's other business management or information technology systems?

Answered: 64 Skipped: 34



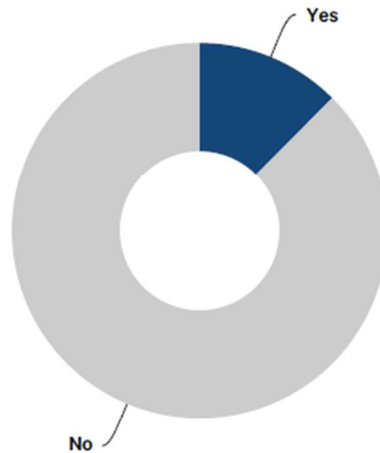
POOR	FAIR	GOOD	GREAT	EXCELLENT	N/A, UNKNOWN	TOTAL	WEIGHTED AVERAGE
6.25%	4.69%	12.50%	3.13%	4.69%	68.75%	64	2.85
4	3	8	2	3	44		

Conclusions

One of the major benefits of GIS is how it can integrate with existing information technology systems. As a rule, any IT system the City owns most likely has data that has a geospatial component (address, location, parcel number, asset number). These systems should be linked to GIS in such a way that their data is made available to users via the GIS. Most users are probably unaware of this capability and need to be educated as to this core facet of enterprise-wide GIS. Additionally, any new IT system acquisition should include core members of the GIS team to ensure that the selected system fully leverage GIS.

Q30 Do you use mobile solutions to access, edit or create GIS data?

Answered: 64 Skipped: 34



ANSWER CHOICES	RESPONSES	
Yes	12.50%	8
No	87.50%	56
TOTAL		64

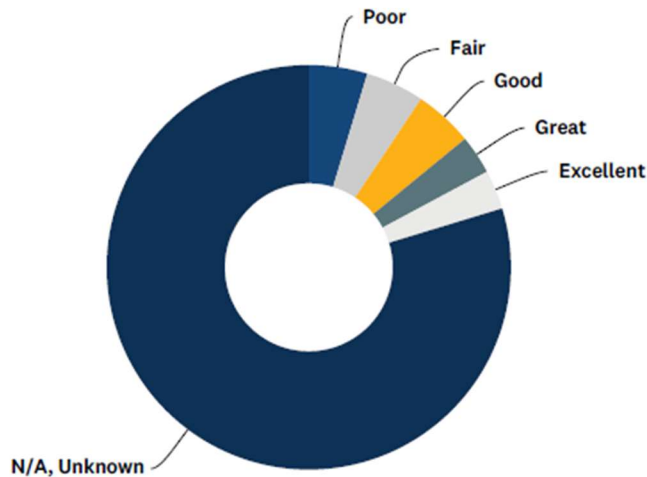
#	TELL US MORE:
1	But , it would be great to utilize such a tool.
2	n/a
3	would like to utilize mobile more
4	Our operation is in the early stages of implementing mobile solutions.
5	Integration with Lucity to edit GIS information by field crews
6	Atlas-Inspector mobile

Conclusions

There is some mobile use, but there is a desire to more heavily utilize mobile tools for viewing and editing GIS data when out of the office.

Q31 How would you rate the integration of GIS with your mobile devices?

Answered: 64 Skipped: 34



POOR	FAIR	GOOD	GREAT	EXCELLENT	N/A, UNKNOWN	TOTAL	WEIGHTED AVERAGE
4.69%	4.69%	4.69%	3.13%	3.13%	79.69%	64	2.77
3	3	3	2	2	51		

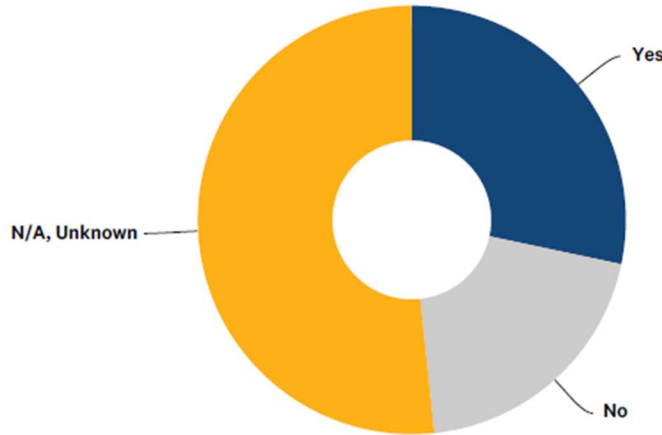
#	TELL US MORE:
1	It's not being used at the police department
2	data accuracy need some improvement. need UCI addresses

Conclusions

There is some mobile mapping use, but there is a desire to more heavily utilize mobile tools for viewing and editing GIS data when out of the office.

Q32 Do you have 24/7 availability to GIS applications?

Answered: 60 Skipped: 38



ANSWER CHOICES	RESPONSES	
Yes	28.33%	17
No	20.00%	12
N/A, Unknown	51.67%	31
TOTAL		60

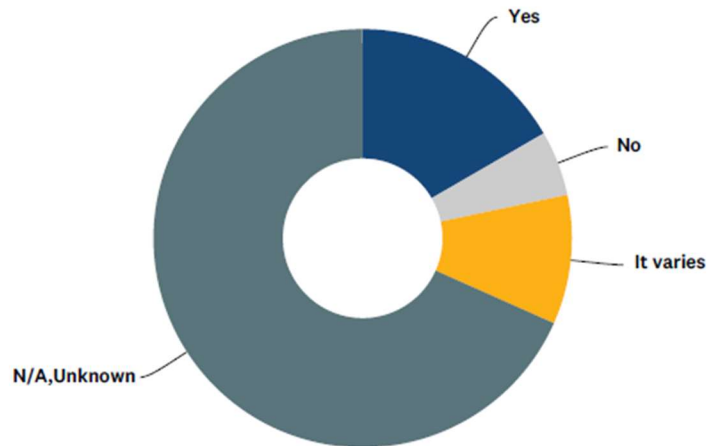
#	TELL US MORE:
1	Only at work
2	I only acces GIS during work hours (at work desktop)

Conclusions

Some respondents realize there is 24/7 access to GIS applications and data. The bottom line is that staff at Irvine will be able to access key data anytime and anywhere as appropriate as the GIS continues to mature.

Q33 Are GIS data layers and/or software solutions used by other departments also accessible to you?

Answered: 60 Skipped: 38



ANSWER CHOICES	RESPONSES	
Yes	16.67%	10
No	5.00%	3
It varies	10.00%	6
N/A, Unknown	68.33%	41
TOTAL		60

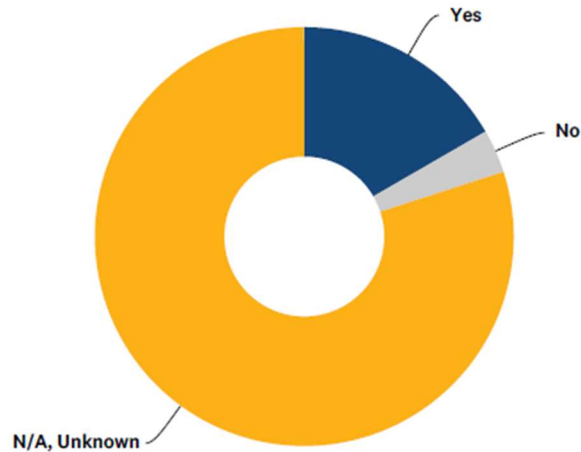
#	TELL US MORE:
1	GIS layers are available, I'm not sure about applications
2	Have some layers that CD has; don't think there are any PW layers available

Conclusions

This user base will need continued education as to what is available to them and the central GIS team will need to ensure that all tools and data are available to staff as needed.

Q34 Does your current system have daily backup procedures?

Answered: 60 Skipped: 38



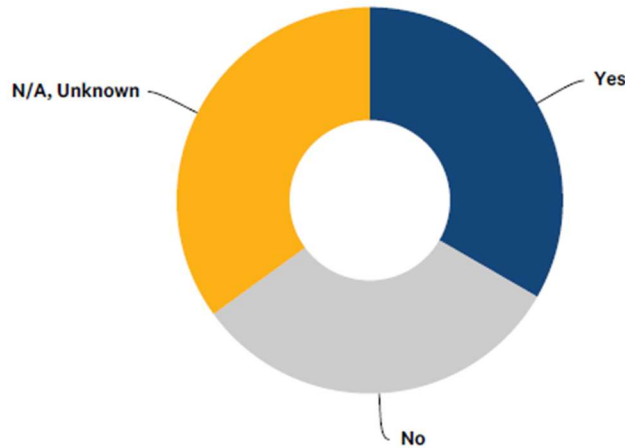
ANSWER CHOICES	RESPONSES	
Yes	16.67%	10
No	3.33%	2
N/A, Unknown	80.00%	48
TOTAL		60

Conclusions

Backup procedures are in place at the City. The geospatial data is being backed up and as the use of geospatial technology is expanded, optimal backup and redundancy strategies need to be evaluated annually.

Q35 Do you experience any issues with network connectivity or speed?

Answered: 60 Skipped: 38



ANSWER CHOICES	RESPONSES	
Yes	33.33%	20
No	31.67%	19
N/A, Unknown	35.00%	21
TOTAL		60

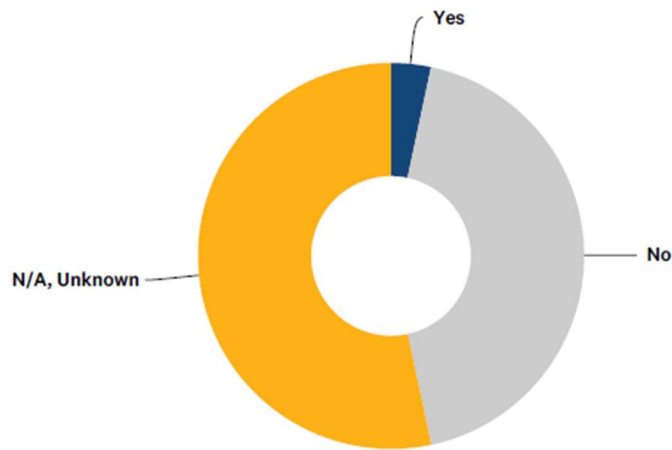
#	TELL US MORE:
1	In general, speed while opening programs in the morning
2	Outlook and One Solution
3	I blame the internet at Harvard Park though, not GIS
4	Not at the office
5	Occasionally, but I think that's a problem with our network, not GIS
6	OSF very very slow, but I see fiber currently being installed
7	Sometimes . . . doesn't everyone?

Conclusions

Some respondents expressed concern regarding speed or access to GIS applications or data. Network connections and users' workstations should be analyzed to identify the cause for slow applications. Slow response times are very detrimental to the use of geospatial technology.

Q36 Have you experienced any issues with data storage capacity?

Answered: 60 Skipped: 38



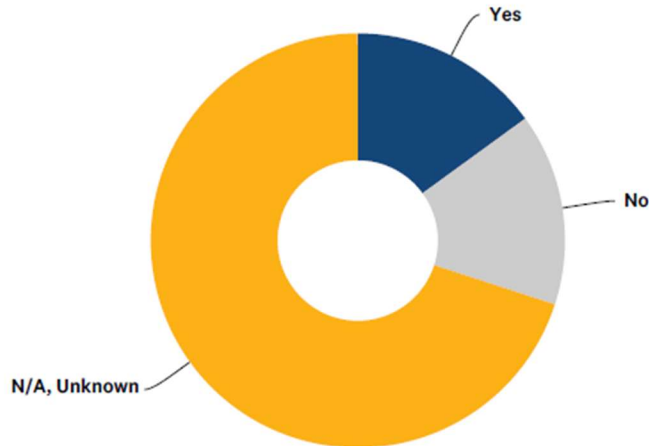
ANSWER CHOICES	RESPONSES	
Yes	3.33%	2
No	43.33%	26
N/A, Unknown	53.33%	32
TOTAL		60

Conclusions

Minimal data storage issues exist. The cost of data storage has dropped dramatically over the past years. Geospatial data requires voluminous space but it for most organization storage space has become a non-issue.

Q37 Are the GIS-enabled devices available to you sufficient in maximizing your use of GIS?

Answered: 60 Skipped: 38



ANSWER CHOICES	RESPONSES	
Yes	15.00%	9
No	15.00%	9
N/A, Unknown	70.00%	42
TOTAL		60

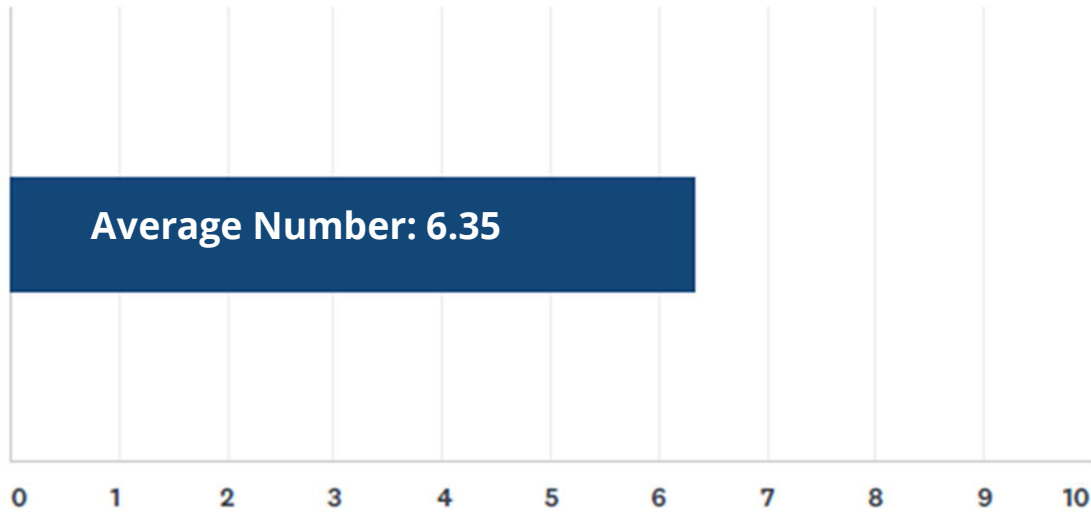
#	TELL US MORE:
1	We really need Portal on the PD side so we can push out information to our officers
2	I could use more training to understand the capabilities of our system

Conclusions

The responses indicate a lack of awareness of how and where GIS can and should be used and a lack of overall GIS enabled devices.

Q38 On a scale of 1-10, how would you rate the enthusiasm for GIS technology in the organization?

Answered: 43 Skipped: 55

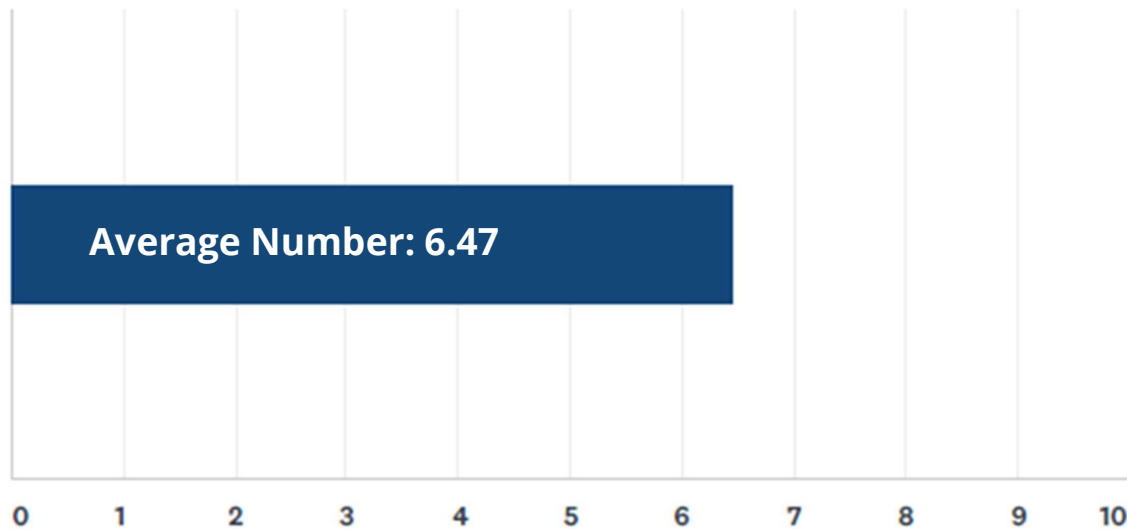


Conclusions

Overall the ones that responded have enthusiasm about how GIS can impact the organization. The number of those that skipped the question indicates that more education is needed to ensure that staff understand the capabilities of the technology.

Q39 On a scale of 1-10, how would you rate organization's commitment to growing your abilities as a GIS User?

Answered: 38 Skipped: 60

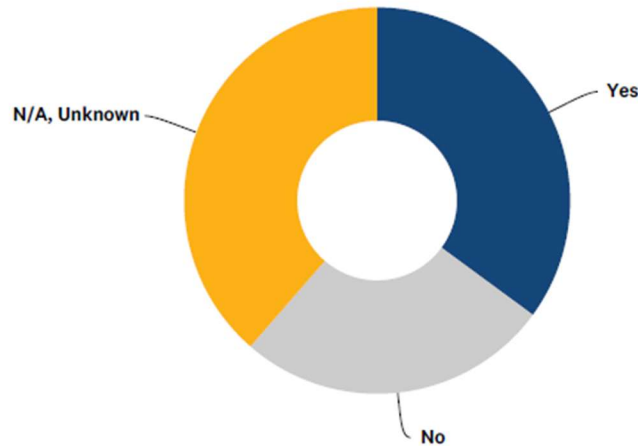


Conclusions

There needs to be a more concerted effort regarding GIS training, education, and knowledge transfer. Users need to be educated on what is available to them through a variety of educational venues.

Q40 Does your organization provide any formal GIS training via workshops, classes or tutorials?

Answered: 57 Skipped: 41



ANSWER CHOICES	RESPONSES	
Yes	35.09%	20
No	26.32%	15
N/A, Unknown	38.60%	22
TOTAL		57

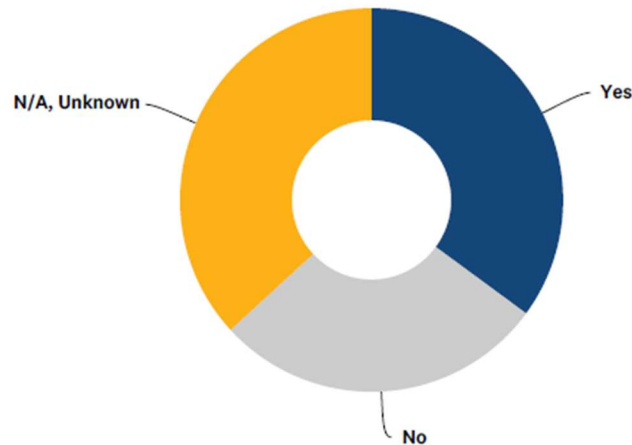
#	TELL US MORE:
1	Never been a part of one though.
2	1 time per year
3	I'm provided with GIS training when I need it
4	Not had any training/tutorials in quite awhile.
5	rely on ESRI classes
6	I attend the GIS day each year
7	I hear about GIS at GIS day - but would be interested in working collaboratively and learning more.
8	Not from the organization, but organization supports training when I find it on my own.

Conclusions

There needs to be a more concerted effort regarding GIS training, education, and knowledge transfer. An on-going GIS training plan should be established for users at all levels.

Q41 Has your organization enabled you to attend any local, regional, or national GIS conferences or other user gatherings?

Answered: 57 Skipped: 41



ANSWER CHOICES	RESPONSES	
Yes	35.09%	20
No	28.07%	16
N/A, Unknown	36.84%	21
TOTAL		57

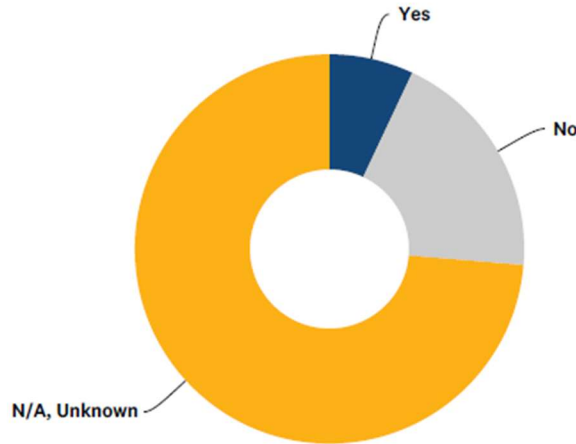
#	TELL US MORE:
1	Not needed
2	City's annual GIS Day
3	Haven't asked
4	I usually attend the annual ESRI conference
5	We have been invited the GIS days, but unaware of the ability to use in my current duties
6	ESRI UC

Conclusions

Some users have attended GIS conferences. There needs to be more effort to enable staff to attend such events. Local, regional and national conference attendance should be part of the GIS training plan.

Q42 Does your organization have a user's group or similar body that meets on occasion to talk about and/or work with GIS?

Answered: 57 Skipped: 41



ANSWER CHOICES	RESPONSES	
Yes	7.02%	4
No	19.30%	11
N/A, Unknown	73.68%	42
TOTAL		57

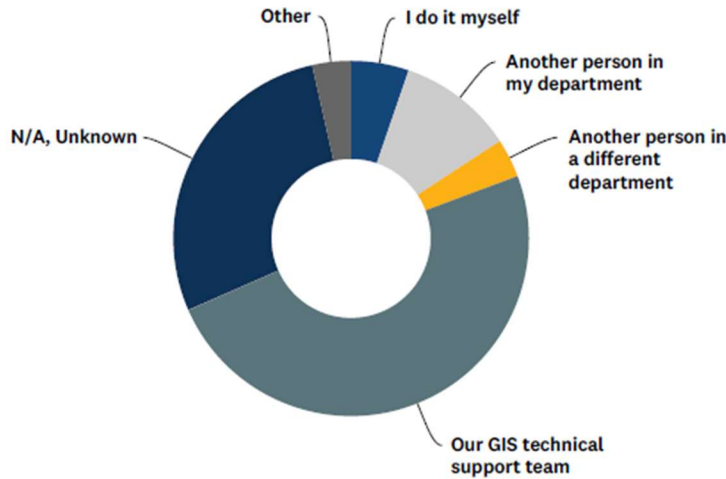
#	TELL US MORE:
1	We talk on the phone or in person as needed
2	OCGIS User Group has quarterly meetings
3	We used to have steering committee

Conclusions

A group similar to the Orange County GIS user group should be formed at the City. This group should plan to meet quarterly at a minimum.

Q43 Who do you turn to for GIS technical support, advice, training, education or other knowledge-based support?

Answered: 57 Skipped: 41



ANSWER CHOICES	RESPONSES	
I do it myself	5.26%	3
Another person in my department	10.53%	6
Another person in a different department	3.51%	2
Our GIS technical support team	49.12%	28
An outside agency	0.00%	0
N/A, Unknown	28.07%	16
Other	3.51%	2
TOTAL		57

#	OTHER
1	A. Dennis Hernandez
2	IT department Liaison blocks/delays access to GIS team

Conclusions

The GIS Technical support team is the most widely used option for GIS technical support and assistance. This shows a good understanding of the GIS Governance model in place at the City. This study will make additional recommendations in regards to centralized support, knowledge base tools, and ways to ensure that all staff have the appropriate support available to them.

GIS Benchmarking, Gap Analysis, Recommended Solutions, and SWOT

City of Irvine | CA

Table of Contents

Benchmarking and
Benchmarking & KPIs 1

 Introduction..... 1

 GIS Benchmarking..... 1

 Methodology..... 2

 The Six Pillars..... 3

Benchmark Results..... 4

 Key Performance Indicators..... 4

 Governance Model 4

 Gap Analysis 4

 Metric 1: Formalized Governance Model – 0% 5

 Metric 2: Job classifications - 100% 5

 Metric 3: Enterprise GIS Project Management – 30%..... 6

 Metric 4: GIS Steering Committee – 0%..... 6

 Metric 5: GIS User Group – 30% 7

 Metric 6: Regionalization of GIS – 50% 7

 Metric 7: GIS Policies and Mandates – 20% 7

 Metric 8: User Sensitivity – 70%..... 8

 Metric 9: GIS Collaboration – 50% 8

 Metric 10: Measure Quality of Service –30%..... 9

 Metric 11: GIS authority and clear lines of responsibility – 50%..... 9

 Metric 12: A GIS budget or funding model – 100%..... 9

 Metric 13: GIS Work Plan – 0% 10

 Metric 14: Develop Key Performance Measures or Indicators for the GIS Initiative – 0% 10

 Metric 15: Create Alignment with The Organization’s Vision, Goals, and Objectives - 10% 11

 Service Level Agreements – 0% 11

 Data and Databases..... 12

 Gap Analysis 12

Metric 1: Digital Data Assessment and Review – 0%	12
Metric 2: Master Data List - 50%.....	13
Metric 3: Metadata - 0%	13
Metric 4: Critical Base Data Layers – 90%.....	13
Metric 4A – Parcels 90%.....	14
Metric 4B – Address Points 80%	14
Metric 4C – Street Centerlines 90%.....	14
Metric 4D – Aerial Photography 100%.....	15
Metric 5: Department Specific Layers - 50%	15
Metric 6: Enterprise Database Design – 0%.....	15
Metric 7: Data Creation Procedures- 50%.....	16
Metric 8: Central Repository – 60%.....	16
Metric 9: Custodianship (Data Stewards) – 60%.....	16
Metric 10: Open Data - 0%	17
Procedures, Workflow, and Integration	17
Gap Analysis	17
Metric 1: Enterprise Integration – 30%.....	18
Metric 2: Identify Opportunities and Gaps- 40%	18
Metric 3: Departmental Access to Critical Data Layers – 70%.....	19
Metric 4: GIS Standard Operating Procedures - 30%.....	19
Metric 5: GIS Application Acquisition/Development Procedures - 20%	20
Metric 6: Data Duplication - 30%	20
Metric 7: GIS Technical Support (Ticketing/Help Desk) – 10%	20
Metric 8: Departmental use of GIS – 20%	21
GIS Software	21
Gap Analysis	21
Metric 1: Appropriate GIS Licensing- 50%.....	22
Metric 2: Commercial Off-The-Shelf versus Custom Code – 70%	22
Metric 3: Access to Software – 20%.....	23
Metric 4: Intranet – 50%	23
Metric 5: Public Facing Tools – 60%.....	23
Metric 6: Specialized Software Extensions - 0%	24
Metric 7: Mobile Software – 30%	25

Metric 8: Mobile Resource Management (MRM) – 0%.....	25
Infrastructure.....	27
Gap Analysis	27
Metric 1: Strategic Technology Plan - 100%	27
Metric 2: GIS Architectural Design – 100%.....	27
Metric 3: IT Infrastructure - 50%.....	28
Metric 4: IT Replacement Plan – 20%.....	28
Metric 5: Provide GIS Training for IT Professionals – 0%	28
Metric 6: 24/7 Availability - 10%.....	29
Metric 7: Data Storage – 40%	29
Metric 8: GIS Mobile Action Plan – 0%	29
Metric 9: Staging Servers – 100%.....	30
Training, Education, and Knowledge Transfer – 27%.....	30
Gap Analysis	30
Metric 1: Develop a Formal On-Going GIS Training Plan– 0%.....	31
Metric 2: Conduct Multi-Tiered GIS Software Training – 0%	31
Metric 3: Conduct Mobile Software Training – 0%.....	31
Metric 4: Ensure Departmental-Specific Education – 40%	32
Metric 5: Conduct ROI Workshops – 0%.....	32
Metric 6: Implement Knowledge Transfer Techniques – 60%	32
Metric 7: Conferences – 50%	33
Metric 8: Online Seminars and Workshops – 30%	33
Metric 9: Conduct Brown Bag Lunches –90%.....	33
Metric 10: Establish GIS Succession Planning - 0%	34
SWOT Analysis.....	35
Overview	35
Strengths	35
Weaknesses	35
Opportunities	35
Threats.....	35
Governance.....	35

Strengths.....	35
Weaknesses.....	36
Opportunities.....	37
Threats.....	38
Data and Databases.....	38
Strengths.....	38
Weaknesses.....	39
Opportunities.....	39
Threats.....	40
Procedures, Workflow and Integration.....	40
Strengths.....	40
Weaknesses.....	40
Opportunities.....	41
Threats.....	41
GIS Software.....	41
Strengths.....	42
Weaknesses.....	42
Opportunities.....	42
Threats.....	43
Infrastructure.....	43
Strengths.....	43
Weaknesses.....	44
Expanded use of field computing will necessitate expanded support Opportunities..	44
Threats.....	44
Training, Education and Knowledge Transfer.....	44
Strengths.....	44
Weaknesses.....	45
Opportunities.....	45
Threats.....	45

Benchmarking & KPIs

Introduction

It has been said that, “if you do not know where you are going, any road will take you there.” Such is true with GIS, and although the benefits are clear and known, many organizations do not have a destination in mind and often fall into the trap of having a GIS program that is ineffective and unproductive.

One of the reasons that many GIS initiatives fail to reach full potential is the absence of metrics and goals. The relationship between metrics and goals is a cyclical one – without metrics, there is no basis for setting goals and gauging progress; without goals, there are no outcomes to measure based on metrics. The success of GIS in the City of Irvine will rely on effective metrics and achievable goals, reviewed annually to evaluate progress and refine objectives. Committing to both will help the City:

- Define success
- Prioritize objectives
- Devise a path forward
- Stay on the desired course

GIS Benchmarking

It is important for the City of Irvine to establish a baseline from which to gauge the success and progress of the enterprise-wide GIS effort. Without metrics, organizational GIS programs often drift over time without focus and clarity. These organizations know that GIS has benefits and they should be using GIS but are not tracking its success. Therefore, it is very important that cities establish metrics and begin to benchmark performance and progress against these metrics. GIS Benchmarking is a structured methodology that uses the identified gaps in an organization to compare actual existing performance with a potential or desired future performance.

This chapter focuses on establishing key metrics and performance indicators (KPIs). This information should be tracked annually to identify progress and areas that need further attention. KPIs allow a GIS program to:

- Define what success looks like;
- Focus everyone on goals;
- Measure – what gets measured gets done;
- Encourage accountability;
- Provide an opportunity for small and large victories;
- Provide a baseline for detailed annual goals;
- Measure success and progress.

Methodology

The Benchmarking Analysis (BA) is a subjective evaluation of the existing GIS conditions of the City. It is a checklist of tasks that conventional wisdom and Industry knowledge identify as prudent and essential to the success of any enterprise GIS. The six categories of the BA are collectively referred to as the “Six Pillars of GIS Sustainability” and each component can then be used as a Best Business Practice (BBP) gauging mechanism for a successful strategic, enterprise, scalable, resilient, and enduring GIS. Each of the six pillars has a sequence of questions that are graded on a 1 to 10 scale — 1 being poor and needs significant improvement and 10 being BBP or excellent. Each component is weighted equally, that is to say they have the same importance to the organization.

An initial assessment is conducted through an interview process whereby a grade is given for each individual items. These results are then refined during the course of the planning process based on departmental and organizational feedback and empirical evidence (example: Detailed analysis of data layers). This results in an accurate and objective comprehensive picture of the organization’s strengths, weaknesses, gaps, opportunities, and KPI’s. A byproduct of the BA is a series of Key Performance Indicators (KPIs). These KPIs should be used as a systematic way of monitoring progress over time.

The Benchmarking interview was held on February 6, 2019 with David Holdstock, Geographic Technologies Group CEO, interviewing Rebecca Bridgeford, Great Park Project Administrator and Mike Sheeran, GIS Supervisor from the City of Irvine. The KPIs were refined based on information discovered during the interview and data gathering processes.

The Six Pillars

The following sections discuss the City's existing conditions as it relates to "Six Pillars of GIS Sustainability". These pillars are the major areas that must be planned and working well to have an effective GIS program. The pillars are:

1. **Governance**
2. **Data and Databases**
3. **Procedures, Workflow and Integration**
4. **GIS Software**
5. **IT Infrastructure**
6. **Training, Education and Knowledge Transfer**

The following are the benchmarks created from an initial discovery call with key City staff and information gleaned from the on-site interviews. These should be updated annually to track progress.

Benchmark Results

Key Performance Indicators

The following are the benchmarks and KPIs created from on-site interviews and associated follow-up correspondence with key Irvine staff. They are grouped by the Six Pillars.

Governance Model

After a full benchmarking analysis was completed, the average score for Governance Model was calculated to be 32%. KPI's have been created based on departmental interviews, questionnaires and supporting documentation. The following are the recommend governance tasks and KPI's.

Gap Analysis

These items are considered gaps in the Irvine GIS program. The following will address these missing items along with other benchmarked metrics and detail expectations for each.

- **Formalized Governance Model**
- **Enterprise GIS Project Management**
- **GIS Steering Committee**
- **GIS User Group**
- **Regionalization of GIS**
- **GIS Policies and Mandates**
- **GIS Authority and Clear Lines of Responsibility**
- **Annual Detailed GIS Work Plan**
- **Develop KPIs for the GIS Initiative**
- **Alignment with Organization's Vision, Goals, and Objectives**
- **Service Level Agreements (SLAS)**

Metric 1: Formalized Governance Model – 0%

The term *governance model* refers to the constellation of relationships between individuals and departments within an organization. A governance model document lays out lines of responsibility and the hierarchy of decision-making power within an organization. These lines connect executives, managers, and staff, or more broadly the stakeholders. A stakeholder is any individual directly affected by an organization's activities. Formalizing a governance model allows an organization to maximize accountability and efficiency. It designates the tasks each organizational entity must accomplish.

In the City of Irvine's case, the governance model has yet to be formalized. The City has a GIS team, under the Information Technology Division seated in the Administrative Services department, which allows equal service to all departments.

Recommendation

The City should use the evaluation in the Governance section of this plan to formalize a Governance model which best meet the needs of the organization.

Metric 2: Job classifications - 100%

The various positions within an organization should be classified according to the formalized governance model. These job classifications denote the skill set, financial worth, decision-making power, hierarchical standing, and overall responsibilities of a given position within the organization. Keep in mind that these job classifications may need adjustment over time. As various departments add GIS as a skill, the job positions should reflect this. The Governance Chapter of this plan further addresses this need.

There are several GIS class specifications already in place at the City:

- GIS Supervisor
- GIS Senior Analyst
- GIS Analyst
- GIS Application Specialist

Recommendation

Promote the use of these job classes throughout the organization to garner GIS skills within departments.

Metric 3: Enterprise GIS Project Management – 30%

Enterprise GIS Project Management is the art of managing, monitoring and coordinating all GIS activity within local government organizations.

The GIS section participates in all GIS initiatives Citywide. However, the challenge is bringing awareness to all departments. The program is operating more in a tactical mode at this time, without true enterprise project management.

Recommendation

There should be further coordination between the IT GIS team and the user departments. This strategic plan is a great document for reviewing projects and needs at set intervals.

Metric 4: GIS Steering Committee – 0%

A GIS steering committee is a group that is composed of top-level organizational leaders and GIS specialists. This group often includes all departmental directors of an organization, along with top financial and administrative officers and the GIS coordinator. The steering committee allocates resources for the organization's GIS needs and determines the schedule, priority, and policy issues that are related to implementation. A coherent GIS steering committee is crucial for a smooth implementation process, as it allows direct interfacing between executive decision makers and GIS experts.

The City was given a 0% on this metric since there is no formal GIS Steering Committee.

Recommendation

It is recommended that a formal executive-level steering committee be formed and meet at least quarterly.

Metric 5: GIS User Group – 30%

A GIS user group is a cohort of stakeholders who share information and compare experiences with GIS technology for the benefit of all members. A GIS user group is typically managed by a GIS Manager and meets frequently, often every month or each quarter.

A working group has been started for this GIS Strategic Plan project, with one staff per dept from Analyst to Deputy Director level.

Recommendation

The momentum of the working group should be harnessed into a GIS User Group. They should plan to meet on a regular basis, with education and sharing success stories as the focus. More information on how a GIS User's Group should operate can be found in the Governance Chapter of this report.

Metric 6: Regionalization of GIS – 50%

Regionalization is a formalized agreement between parties or entities to cooperate. In relation to geospatial technologies, regionalization is the sharing of data, resources, applications, training, and education and more between disparate groups of GIS users in the region seeking to pool their resources and achieve similar goals. Often, memorandums of understanding (MoUs) guide the regionalization of GIS technologies, where multiple organizations, grouped by geography, share data with one another.

The City is sharing data informally with Orange County Fire, and therefore has received a score of 50%.

Recommendation

Formalize agreements with Orange County, State of California, and regional organizations, especially as regards access to core data sets, such as parcels, aerial imagery, fire services.

Metric 7: GIS Policies and Mandates – 20%

Policies refer to procedural codes of conduct that are ratified and enforced by organizational authorities. These policies are internally imposed and guide everything from data and resource sharing within the GIS initiative to financial concerns for the City at large.

SOPs are critical for the sustainability of the GIS effort and must be created to ensure that the GIS success can be propagated.

The City has data standards that contractor must adhere to; therefore, received a score of 20%.

Recommendation

There are a number of SOPs that can be created to further ensure standardization of GIS in the City, such as data creation and maintenance, addressing and ArcGIS Online maintenance.

Metric 8: User Sensitivity - 70%

User sensitivity refers to the capabilities of a particular GIS technology to fluidly respond to a user's request for information. User sensitivity is an important measure of the relative benefits of implementing GIS technology. The Voice of the Customer (VOC) survey is a key way to measure delivery of service and satisfaction.

Irvine GIS has received a satisfaction rating of 93% in recent City government user satisfaction surveys, therefore a score of 70% has been given.

Recommendation

User sensitivity should be measured annually with a user satisfaction and input survey.

Metric 9: GIS Collaboration - 50%

GIS collaboration refers to the productive cooperation between individuals and entities facilitated by the implementation of GIS technology. High levels of GIS collaboration let an organization, or organizations, derive maximal benefits from enterprise GIS technologies. It is both a by-product and end goal of geospatial technology.

Irvine IT GIS staff work with most departments. However, based on the Voice of the Customer surveys and onsite interviews there is a significant opportunity for more GIS user and further collaboration; thus, the City has been given an 50% score.

Recommendation

The team should use this GIS strategic plan to promote collaboration and to approach other departments or divisions who are not participating fully in GIS today.

Metric 10: Measure Quality of Service –30%

Measuring quality of service refers to a City's capacity to gather feedback data about the efficacy of its geospatial technologies. The City's quality of service can be examined through questionnaires and interviews or metrics that are related to user interface and objective goals.

The Voice of the Customer survey that was administered as part of this project is one way to garner client feedback. Overall a score of 30% was given because no systematic feedback loop is in place to solicit feedback.

Recommendation

A formal project and customer service feedback mechanism should be put into place and the annual VOC will help move this to a higher score. Additionally, the GIS team should solicit quantifiable feedback from customers throughout the year.

Metric 11: GIS authority and clear lines of responsibility – 50%

A line of responsibility describes the vertical chain of liability and authority in an organization. In common-sense terms, a line of responsibility formally lays out who is responsible for what and to whom.

As indicated in the interviews, staff are aware of who to go to for assistance and who is in charge of various components of the GIS; however, some departmental GIS activity occurs apart from the IT GIS team's purview. Therefore, the City has been given a score of 50%.

Recommendation

Continue to promote the IT GIS team Division as the authoritative office for GIS core activities.

Metric 12: A GIS budget or funding model – 100%

A funding model is a methodical and institutionalized approach to building a reliable revenue base to support an organization's core programs and services. In our context, an organization's funding model explains informal financial terms, how the geospatial technology initiative will be funded.

GIS at the City is within the Information Technology division, and has its own separate line items in the division's budget.

Recommendation

Review the GIS budget annually and prepare budget items to support the annual goals.

Metric 13: GIS Work Plan – 0%

A work plan proposes the schedule and budgeting for a specific project. It not only offers a step-by-step description of the ways that a plan will be enacted but also projects a timeline and explains how funding will be deployed within the plan's framework. The work plan associated with a GIS initiative should be updated on an annual basis to reflect the evolving needs and priorities of a GIS enterprise organization. Essentially, it lays out a work plan for the GIS team as it relates to the priorities of the GIS steering committee and each department.

The GIS team works on a reactionary basis, without a formal work plan.

Recommendation

This strategic plan will lay the foundations for a formal work plan. Create a formal work plan annually in conjunction with update to the GIS Strategic Plan. Share with the organization each year and give progress reports to the GIS user groups and Steering Committee.

Metric 14: Develop Key Performance Measures or Indicators for the GIS Initiative – 0%

Key performance measures or key performance indicators (KPIs) are organizationally ratified metrics that gauge whether and how specific goals are met. These objectives, numeric representations of success or failure are crucial when comparing the costs and benefits of the GIS initiative.

As there are no KPIs in use at Irvine GIS as this time, this document will serve as the starting point for KPIs.

Recommendation

Use the KPIs in this report to continue measurements of performance.

Metric 15: Create Alignment with The Organization's Vision, Goals, and Objectives - 10%

The enterprise GIS needs to be aligned with the City's vision, goals, and objectives. This is necessary from the ground up. Simplistically, the vision of a City may be to improve life for its community; enterprise GIS supports this vision by identifying areas that need improvement and giving decision makers the capacity to set realistic, data-backed goals (such as improved emergency service response time). These goals would then be broken down into objectives to be measured by KPIs.

While there is no concerted connection between IT and Irvine City Council goals, the GIS team does prepare CIP maps for the public, helping to fulfill the transparency goal of the City Manager.

Recommendation

An alignment exercise should follow the State of the City Address held in February.

Service Level Agreements - 0%

The parameters of a Service Level Agreements (SLA) are defined by the KPIs that are relevant to the technologies in question. In terms of GIS, SLAs are formal, binding agreements that outline what stakeholders can expect from an enterprise GIS. These agreements can document how the GIS group will support each department within the City.

Recommendation

The City should develop both enterprise and departmental SLAs.

Data and Databases

After a full benchmarking analysis was completed, the average score for Data and Databases was 49%. One of the strengths of the Irvine GIS program is the GIS data and the number of staff that maintain key data sets. See the Benchmarking Bar Chart below to review individual Data and Database items. Opportunities exist to further leverage the GIS data and one part of this overall study is to make detailed data recommendations.

Gap Analysis

These items are considered gaps in the Irvine GIS program. The following will address these missing items along with other benchmarked metrics and detail expectations for each.

- Digital Data Assessment and Review
- Master Data List
- Metadata
- Department Specific Layers
- Enterprise Database Design
- Data Creation Procedures
- Custodianship (Data Stewards)
- Open Data

Metric 1: Digital Data Assessment and Review – 0%

A digital data assessment examines the completion and breadth of an organization's existing data layers. It evaluates the accuracy, completeness, and overall health of the existing digital data layers within an organization. Once the data are assembled, gaps and weaknesses are identified and subsequently improved. There is an effort to continually improve data by getting feedback from various departments and the public.

A systematic review of the data quality has not been done at the City, therefore a score of 0% is given.

Recommendation

The central GIS team should use various tools such as the Esri Data Reviewer to analyze the veracity of GIS data and to identify and fix any issues.

Metric 2: Master Data List - 50%

The Master Data List (MDL) enumerates all of the data sets that an organization needs for enterprise GIS implementation. The various datasets should be detailed by type and source and assessed in terms of their quantities, accessibility, and formats. The core corporate spatial datasets are managed in an enterprise spatial database and an MDL is maintained for this.

Currently GIS team maintains a master list of every layer that resides in the GIS central repository; however, the list does not include department data.

Recommendation

The GIS team should work on providing a complete enterprise-wide MDL that is readily accessible as a check list so that users can select layers that they want in their various GIS applications.

Metric 3: Metadata - 0%

Metadata describes the collective characteristics of data. In short, metadata is data about data. Metadata details how, when, and where data has created or collected its documents' scale, accuracy, resolution and other properties.

The City maintains very little metadata at this time.

Recommendation

The City should begin a program to build metadata and have subject matter experts (SMEs) participate in its upkeep.

Metric 4: Critical Base Data Layers - 90%

In the context of geospatial technology, a data layer is the visual expression of accumulated data of a particular type. Critical base data layers refer to the data layers that are central to the GIS initiative and are mandatory for the successful use of GIS at a City.

At Irvine, base layers are stored centrally and data management is performed by the GIS section. Currently there are over 360 data layers supporting Police dispatch, crime analysis, street, landscape, facilities, open space inventory, NPDES, Strategic Business Plan, and many other systems. Critical base data layers are examined below.

Recommendation

The Esri Data Reviewer application should be used to test the quality of the data at set intervals.

Metric 4A – Parcels 90%

The cadastral or parcel layer exists and is complete, but is slightly out-of-date. As of this writing, the land parcels layer contains 45,731 parcels.

Parcel information is received from Orange County at regular intervals. The new recorded parcels are converted from CAD format into GIS format, adjustments are made in the exported GIS shapefile and later copied into the production parcel layer, with attributes added.

There should be an effort to acquire and update the Parcel data more frequently.

Metric 4B – Address Points 80%

An address point is a location that is marked by its position relative to a physical structure. An address point is not necessarily the same as a street address. It is a data point that is assigned to a mapped location according to parameters that may or may not coincide with a street address. segments. The IT GIS section maintains the most complete address and parcel inventory in the City. Currently, the building addresses layer contains 81,265 addresses.

Metric 4C – Street Centerlines 90%

The City maintains its own street centerlines dataset; however, the data is duplicated in multiple departments and conflicts exist between the disparate layers. Currently, the street centerlines layer contains 8,281 segments. The GIS section also participates in street naming and address approval process.

Metric 4D - Aerial Photography 100%

Aerial photography is purchased annually from Eagle Aerial. The GIS section houses over 200GB of image files for years 2000 through 2018 (and 1976, 1986, 1992). LIDAR has also been collected, which is used for the Great Park initiative.

Metric 5: Department Specific Layers - 50%

Data custodian groups maintain identified datasets based on their proximity to the business process that originate the data. Some of the data layers are utilized across the corporation. Layers are mapped representations of data that correlate to the goals and objectives of a department(s).

There are dozens of digital data layers at Irvine, but the layers per department varies greatly. For example, Crime analysis data is stored and managed by Public Safety, and Asset Management is stored and managed by Public Works.

Recommendation

The Needs Assessment identified a number of layers that need augmentation and others that do not exist today. Efforts should be made to build these layers and make them available to those users who need them.

Metric 6: Enterprise Database Design - 0%

Enterprise database design refers to the way that a City crafts a data repository in order to meet objectives and further the goals of the City. Enterprise database design usually includes focusing on the data, the use of data models (Esri's Local Government Information Model [LGIM]), and integration strategies. The City may elect to use parts of different data models thus creating a custom Irvine data model.

Over time, the City has developed their own extensive database design, which meets the current needs of the organization.

Recommendation

It is recommended that various standardized models be explored that will help ensure the sustainability of GIS at the City. This database design should be reviewed every few years to ensure it encompasses key advancements in technology.

Metric 7: Data Creation Procedures- 50%

Data creation procedures are the standardizing guidelines by which a City's data are collected, cataloged, and turned into information products. This is an important set of procedures, as it protects against redundancy and needless work, both of which reduce overall cost-effectiveness.

Irvine has formalized documentation only on Addressing procedures.

Recommendation

Standard procedures governing various datasets need to be created and enforced to include in-office and field data creation and maintenance.

Metric 8: Central Repository – 60%

A central repository is an organization's aggregated collection of GIS data, gathered from all information resources. Pooling data in this manner allows for ease of maintenance, monitoring, and collection of metadata. A central repository of GIS data is a characteristic of an enterprise solution.

There is a central GIS server in IT GIS; however, there are also data silos in Transportation and Community Development.

Recommendation

The City should continue to build upon the central data repository in development at this time.

Metric 9: Custodianship (Data Stewards) – 60%

Data stewards are responsible for the administration and upkeep of specific digital data layers. They are custodians in that they monitor the accuracy as well as the security of departmental data.

There are only two departments that maintain their own GIS data: Public Safety and Public Works. The remainder of the GIS data layers are being maintained by the IT GIS team.

Recommendation

Any department-specific layers identified in the Needs Assessments that are created must be given a custodian. The custodianship needs to be formalized with agreement from each data steward department.

Metric 10: Open Data - 0%

Open data and open government describe an increasingly prevalent policy that allows citizens, stakeholders, and non-stakeholders access to an organization's GIS-based data and data layers. Residents and visitors to the City can see the results of a GIS initiative. Thus, a more transparent, open government is the end goal of this policy. At this time, GIS information is available to public only by request.

Recommendation

The City is not using Esri's open data tools but should consider how they can be implemented and if they add additional value.

Procedures, Workflow, and Integration

After a full benchmarking analysis was completed, the average score for Procedures, Workflow, and Integration was 31%. One of the key components to any successful GIS is how well it integrates with other systems and how it improves the overall workflow of the organization. GIS implementations often fail because the GIS is seen as a stand-alone mapping technology. However, in reality, it is a primary integrative tool that should serve as an organization's portal into all of its data. See the Benchmarking Bar Chart below to review individual Procedures, Workflow, and Integration items.

Gap Analysis

These items are considered gaps in the Irvine GIS program. The following will address these missing items along with other benchmarked metrics and detail expectations for each.

- Enterprise Integration
- Identify Opportunities and Gaps
- GIS Standard Operating Procedures
- GIS Application Development Procedures
- Data Duplication
- GIS Technical Support
- Departmental use of GIS

Metric 1: Enterprise Integration – 30%

Enterprise integration describes the process whereby existing IT system data are integrated into the GIS. This could include accessing and viewing data from IT systems within GIS to pushing data from GIS to feed these IT systems.

The corporate GIS database recently has been integrated with Lucity. There is a great opportunity for more integration and automation of the processes.

Recommendations

As the City's GIS matures, integration with all corporate databases should be a goal. Also, the City needs to consider a data mining tool that automates extractions from these IT systems. Additionally, as older systems are replaced a key focus should be ensuring that the replacement systems lend themselves to being well integrated.

Metric 2: Identify Opportunities and Gaps– 40%

Gaps in the enterprise and integrated GIS solution need to be identified and documented. They could include public safety data, permitting data, work order data, or crowdsourcing information. Opportunities are those databases that can effectively be incorporated into the enterprise GIS initiative.

Candidate systems for integration are being identified in this strategic plan. Therefore, the score given is 30% as this strategic plan has identified the gaps and opportunities.

Recommendation

Continue to explore candidate systems for integration and opportunities to incorporate GIS into business processes.

Metric 3: Departmental Access to Critical Data Layers - 70%

Critical departmental data layers are those that are crucial to the GIS enterprise. Departmental access refers to the ease with which various organizational departments may access these layers. Departmental accessibility is a critical component of success. Technically, all departments in Irvine have access to needed data, but not all staff are aware of what is available.

Recommendation

Explore opportunities to improve access through easy-to-use portals and education.

Metric 4: GIS Standard Operating Procedures - 30%

Standard operating procedures (SOPs) are the City's formally ratified blueprint for actions to be taken in pursuit of the desired objective. They are step by step, formulaic, and repeatable. In the geospatial context, SOPs prevent redundancy in data compilation and unnecessary effort. Adoption of SOPs also decreases organizational liability.

Certain procedures are followed internal to the IT GIS team, but not spread to the departments that use GIS.

Recommendation

One of the recommendations of this plan is a focus on process documentation for sustainability of the GIS in the future.

Metric 5: GIS Application Acquisition/Development Procedures - 20%

GIS application acquisition/development procedures are a subset of SOPs detailing the ways in which GIS technologies are to be manipulated in order to meet user needs. Procedures should exist detailing how the organization manages software acquisition and/or custom software development, with an understanding the pros and cons of custom software development.

Currently, GIS is not considered when acquiring new corporate software applications.

Recommendation

IT GIS should document GIS application acquisition/development procedures, including consideration of GIS integration during the procurement process of new business systems, such as acquiring a new CAD vendor.

Metric 6: Data Duplication - 30%

Data duplication is the actual duplication of data layers. The most common GIS data layers that are duplicated in local government are street centerlines, address points, parcels, and, to a lesser extent, boundary layers. Sometimes this is necessary, as the end use of the layer dictates some duplication.

There was some indication that GIS layers were being duplicated unnecessarily, especially at Public Works.

Recommendation

A single authoritative source for core layers would be optimal.

Metric 7: GIS Technical Support (Ticketing/Help Desk) - 10%

Like users of any technology system, GIS users often need help or encounter problems while navigating GIS technologies. The team responsible for an organization's GIS technical support will walk users through issues and provide readily available troubleshooting information.

The GIS team is tracking phone calls.

Recommendation

There is significant opportunity to centralize all support requests and track needs and solutions. This will also create records that can be used for performance measurements.

Metric 8: Departmental use of GIS – 20%

This is the actual utilization of GIS within all departments of local government. In the context of geospatial technology, departmental use implies a decentralized implementation of GIS technologies. This component should examine how effectively the departments are deploying the technology for different needs.

GIS in Irvine is currently under-utilized; there are opportunities for greater use. Therefore, the City was given a score of 20%. This is not indicative of doing a bad job today but more of an indication of the possibilities moving forward.

Recommendation

Use the Needs Assessment and Recommendations in this plan to move forward in putting geospatial technology in place in departments.

GIS Software

After a full benchmarking analysis was completed, the average score for GIS Software was 35%. Software is often the culmination of GIS success. The end user should have access to tools that allow them to serve their clients better and get their job done more effectively. The GIS model in North America has migrated from data creation to data consumption. There is a plethora of tools for targeted needs that have been introduced over the past few years. Most cities need to re-organize their GIS efforts to better harness and support these new software tools. See the Benchmarking Bar Chart below to review individual GIS Software items.

Gap Analysis

These items are considered gaps in the Irvine GIS program. The following will address these missing items along with other benchmarked metrics and detail expectations for each.

- **Appropriate GIS Licensing**
- **Access to Software**
- **Intranet**
- **Specialized Software Extensions**
- **Mobile Software**
- **Mobile Resource Management**

Metric 1: Appropriate GIS Licensing- 50%

The objective of this metric is to measure how available and pervasive GIS software is throughout the organization and to create an optimum and cost-effective licensing strategy. A license agreement is a legal agreement entered into by the organization and a GIS software vendor that stipulates the limitations, liabilities, and appropriate applications of the vendor's technology. An Esri Enterprise Agreement Program (EA) is a fast track to an organization-wide GIS. An EA provides ready and uncapped access to ArcGIS software along with timely and expert assistance from Esri so the organization can focus on building a successful and scalable enterprise GIS.

The City's current Esri licensing Server, Desktop and ArcGIS Online. This plan has identified several opportunities for new software products and usage.

Recommendation

The City should evaluate its GIS software licensing and work with the Esri representative to consider an EA.

Metric 2: Commercial Off-The-Shelf versus Custom Code – 70%

Historically, GIS software companies have not had a wealth of commercial-off-the-shelf (COTS) applications forcing GIS staff to develop custom products. This has changed as Esri and its business partners have released hundreds of configurable solutions ready to implement. Occasionally, organizations still need to develop scripts for data transfer, conversion, or optimizing a process.

While the City prefers COTS applications, some applications in use today are custom. This plan has identified a number of COTS software products that will advance the use of GIS at the City.

Recommendation

The City should pursue more COTS applications software and Esri configuration solutions, instituting custom only when necessary.

Metric 3: Access to Software – 20%

As mentioned earlier, the GIS market has been flooded with new software tools. Most organizations are not equipped to handle all of this software. The traditional City GIS is focused on data, hardware, and the core software products. Usually, there is not enough staff focused on implementing and supporting the wealth of targeted applications.

Irvine staff have done a great job of outfitting the organization with critical software but other opportunities exist. The score of 20% is indicative of the need to implement the software identified in this plan.

Recommendation

Targeted intranet portals, executive dashboards, and a host of other off-the-shelf products would benefit staff.

Metric 4: Intranet – 50%

An Intranet is a web-based GIS solution that is accessible only to an organization's employees. A GIS Intranet solution is housed on a local government private network, accessible only to an organization's staff.

Irvine has done well by implementing an internal intranet Esri web app with basic functionality.

Recommendation

The next step is taking this to the next level, whereby the City has a number of targeted intranet portals serving specific datasets, queries, and reports to groups of departments.

Metric 5: Public Facing Tools – 60%

The introduction of Esri's ArcGIS Online Apps and Story Maps have opened a completely new way of sharing data with the public in an intuitive and graphic rich format. Additionally, crowdsourcing applications like Esri's Public Comment application and various 311 applications allow users to provide information to citizens in a much more dynamic fashion.

The GIS internet site was launched in 2005 to allow the public to look up address, parcel map, general plan, zoning, and flood zone. Since then, additional apps have been added to the City's public Interactive Maps portal:

- **Online Parcel Search**
- **Centerline Ties**
- **Bikeway Map**
- **Street Improvement Plans**
- **Road Construction**
- **City Parks**
- **Open Space Deeds**

(See <http://gis.cityofirvine.org/irvinegis/interactiveMaps.html>)

Recommendation

The City should pursue a broader adoption of a web pattern of GIS and use ArcGIS Online for public facing apps serving specific needs.

Metric 6: Specialized Software Extensions - 0%

The maturation of GIS has resulted in a wealth of specialized software products. Esri has traditionally called these extensions, as they are extensions to the core product but not a part of the core product set. These include Spatial Analyst, Network Analyst, 3D Analyst, and a host of others.

The City does not currently use any of the specialized software; however, the needs assessments identified some new extension opportunities for staff.

Recommendation

Prepare to implement new extension opportunities by researching possible uses and licensing ramifications.

Metric 7: Mobile Software – 30%

Mobile software refers to GIS applications that are designed for mobile use on a tablet or a smartphone. The mobility of GIS is a critical component of any successful enterprise GIS. This is another burgeoning area of GIS. Historically, mobile tools were cumbersome, expensive, and in many cases did not work well or at all. However, this has changed radically over the past few years with new software that works very well via cellular networks and on a variety of hardware platforms (tablets, smartphones, laptops, and other mobile devices). Esri has introduced the Collector and Survey 123 specifically for mobile data collection. Other tools such as the Esri Web AppBuilder allows for the implementation of platform independent software for viewing and analysis in the field.

Landscape maintenance crews have begun to use the mobile LuCity application with GIS when connected to Wi-Fi. This promises to be the biggest growth area in the City for the next few years.

Recommendation

Plan to implement the mobile opportunities that were identified in the needs assessment and look for opportunities as new technologies are deployed.

Metric 8: Mobile Resource Management (MRM) – 0%

GIS is a technology that is integrative to most other local government technologies. Many cities and counties are using GPS enabled devices to pinpoint vehicle, equipment or asset location. GPS enable devices include cellular and/or Wi-Fi connected:

- smartphones,
- tablets,
- sensors, and
- survey units.

This allows an organization to optimize responses, such as public safety for emergencies or field crews for work orders. Collectively all of this technology can be referred to as Mobile Resource Management (MRM). GPS coordinate and attribute data can be displayed on the device, showing live locations if so desired.

Several of the City's departments have started using mobile technology, such as Parks and Public Safety.

Recommendation

As there are several uses of mobile technology identified in this plan, this is a good opportunity to develop a comprehensive MRM strategy.

Infrastructure

After a full benchmarking analysis was completed, the average score for Infrastructure was 47%. Overall, the City IT Department has done a good job of ensuring that the infrastructure of the City meets the business needs. See the Benchmarking Bar Chart below to review individual Infrastructure items.

Gap Analysis

These items are considered gaps in the Irvine GIS program. The following will address these missing items along with other benchmarked metrics and detail expectations for each.

- IT Infrastructure
- IT Replacement Plan
- GIS Training for IT Professionals
- Data Storage
- GIS Mobile Action Plan

Metric 1: Strategic Technology Plan - 100%

A strategic technology plan describes an organization's current and future relationship with technology and outlines how this technology will further the goals of the organization. The components of this plan serve as the bedrock for the GIS platform.

The Information Technology (IT) Division of the Administrative Services Department has created a Strategic Technology Plan for the City and updates it annually. The 2003 GIS Implementation Plan is incorporated into the City's Strategic Technology Plan.

Recommendation

Work with IT to update the comprehensive Strategic Technology Plan to support the GIS Architectural Design.

Metric 2: GIS Architectural Design - 100%

GIS architectural design is the plan that addresses GIS software technology, capacity performance, and IT infrastructure including hardware, network communications, software architecture, enterprise security, backup, platform performance, and data administration.

IT has recently prepared a GIS Architectural Design, therefore giving a score of 100% for this task.

Recommendation

Work with IT to update the implement the GIS Architectural Design.

Metric 3: IT Infrastructure - 50%

IT infrastructure refers to a dynamic web of processes, networks, hardware, and software resources that support the activities of an integrated IT department.

The City has the necessary IT infrastructure in place to support GIS. Recently GIS implemented a Citrix solution which further expands the GIS capability in the City without requiring any upgrade to the standard PC hardware. However, there is no fiber connection to remote buildings and the network is not secure.

Recommendation

The GIS team should work with the IT team to improve GIS performance.

Metric 4: IT Replacement Plan - 20%

An IT replacement plan is a formal plan for updating hardware and software resources in the future. Budgetary concerns, goals, and long-term objectives are taken into account.

While an IT replacement plan has been written for the City, it has not yet been implemented.

Recommendation

System requirement for ArcGIS Desktop and ArcGIS Pro should be reviewed prior to purchase of hardware.

Metric 5: Provide GIS Training for IT Professionals - 0%

In order for IT professionals to assist an organization with crowdsourcing or tech support, they need a proficiency in GIS technologies.

Irvine IT staff have not received the appropriate training to support the GIS effort.

Recommendation

Follow the training opportunities detailed in the Training Chapter of this study.

Metric 6: 24/7 Availability - 10%

The term 24/7 availability refers to the availability of IT infrastructure and GIS technology at all hours of the day, every day of the week.

The City's GIS is available all of the time and VPN is available for remote access.

Recommendation

The need for 24/7/365 availability should be reviewed with the GIS Team, and the considerations discussed with the IT team.

Metric 7: Data Storage - 40%

GIS is data intensive and requires a voluminous amount of storage. This used to be a bigger concern for local governments. However, the cost of data storage has dropped dramatically and the technology has improved so that server farms with a huge array of available disk space is available at most local governments including Irvine.

The City's IT has been trying to free up space, in order to reduce backup costs.

Recommendation

Continue to monitor the available data storage as GIS systems are implemented. Data storage should be a consideration with each new project. Also, alternative technologies of data storage should be explored to handle large, static datasets, such as aerial photographs and LiDAR.

Metric 8: GIS Mobile Action Plan - 0%

A mobile action plan is an outline of the tactics that a city will deploy in order to increase GIS accessibility on tablets and smartphones. The City should deploy a mobile action plan that reflects the current GIS and IT environment. This GIS plan can serve as the basis for mobile GIS.

Recommendation

Standards for mobile hardware, platforms, applications, and field data collection need to be established.

Metric 9: Staging Servers – 100%

Many organizations use their production server as their staging/testing server. A staging server is a site where GIS applications are given full-trial runs.

IT has implemented development, production and staging servers for GIS.

Recommendation

Ensure that separate development and staging zones remain in place for software and databases as the system grows and new browsers, portals and applications are deployed.

Training, Education, and Knowledge Transfer – 27%

After a full benchmarking analysis was completed, the average score for Training, Education, and Knowledge Transfer is 27%. This is one of the most important components to a successful enterprise-wide GIS effort. However, it is the one pillar of GIS success that is most often overlooked or underdeveloped. See the Benchmarking Bar Chart below to review individual Training, Education, and Knowledge Transfer KPIs.

Gap Analysis

These items are considered gaps in the Irvine GIS program. The following will address these missing items along with other benchmarked metrics and detail expectations for each.

- **Formal On-Going GIS Training Plan**
- **Multi-tiered GIS software training**
- **Mobile Software Training**

- Department Specific Education
- ROI Workshops
- Conferences
- Online Seminars and Workshops
- GIS Succession Planning

Metric 1: Develop a Formal On-Going GIS Training Plan- 0%

A formal on-going GIS training plan is a ratified outline of steps, schedules, and costs for continuing to train the City's employees. It is important to have a multi-year, multi-tiered training plan, considering that GIS is a rapidly evolving technology, and organizational needs are ever changing.

As there is no formal training plan at this time, this metric received a score of 0%.

Recommendation

This study can serve as the starting point for the formal training plan moving this metric up significantly once the plan is adopted.

Metric 2: Conduct Multi-Tiered GIS Software Training - 0%

The formal training plan must include multi-tiered GIS software training using a standardized process for training employees at all levels of understanding in the use of GIS technology.

There has not been any GIS training for many years in the City.

Recommendation

A fully developed multi-tiered training plan should be a part of the annual GIS work plan.

Metric 3: Conduct Mobile Software Training - 0%

Mobile software training is the process of teaching users how to engage with GIS technology on their mobile device. This strategic plan identifies the need for ongoing training and workshops on the use of mobile tools.

There has not been any mobile GIS training in the City.

Recommendation

The formal training plan must include mobile software training.

Metric 4: Ensure Departmental-Specific Education – 40%

Departmental-specific education provides specialized training procedures according to a department's specific needs.

There has been some project specific training to meet the departments' needs.

Recommendation

The City should ensure that all departmental GIS users have the appropriate training to carry out the GIS functions necessary to enable them to do their job.

Metric 5: Conduct ROI Workshops – 0%

Return on Investment (ROI) workshops are specific workshops that are related to the value and ROI that GIS offers the City. Each department is an important component in the success of an enterprise GIS.

Recommendation

The City should provide ROI workshops for each department including the City Manager's office.

Metric 6: Implement Knowledge Transfer Techniques – 60%

Knowledge transfer refers to the process of communicating the GIS know-how and knowledge among different entities in the City. Knowledge transfer is the art of transferring knowledge from one part of the City to another.

The City has held annual GIS Day events for several years.

Recommendation

There needs to be a strategy for transferring and documenting knowledge to ensure that the GIS program is sustainable.

Metric 7: Conferences – 50%

Conferences are gatherings of the GIS that provide a range of opportunities for furthering employee GIS education. Talks, lectures, lessons, and socialization with other industry professionals are ways to advance an understanding of geospatial technologies and keep abreast of new developments.

Irvine's GIS Supervisor and at least one other manager attends local conferences and encourages key staff to attend.

Recommendation

The City should continue to send a few staff each year to the Esri User's Conference in California.

Metric 8: Online Seminars and Workshops – 30%

Online seminars and workshops are online programs implemented by a variety of organizations that further GIS education among employees.

The GIS management and team members have watched online seminars and workshops.

Recommendation

Online seminars and workshops should be further promoted to others in the organization. Monitoring of usage of these opportunities needs to be done and become a part of individual growth plans.

Metric 9: Conduct Brown Bag Lunches –90%

Brown bag lunches are as informal as they sound. This term refers to a free-and-easy meeting, generally held over a meal, where employees can discuss concerns with GIS team members and users in a social setting.

The CIO has held 'tech talks' on GIS topics, where about 30 people were in attendance.

Recommendation

Irvine should continue to provide these monthly events, focusing on key training opportunities and sharing success stories.

Metric 10: Establish GIS Succession Planning - 0%

Succession planning refers to an organization's strategy for filling essential positions with experienced employees. There are a number of succession planning strategies that can be applied, such as cross-training and system documentation.

Irvine does not currently perform any succession training.

Recommendation

The GIS team should ensure a formal GIS succession plan is in place.

SWOT Analysis

Overview

Based on findings from the online survey and on-site interviews, GTG compiled a list of Strengths, Weaknesses, Opportunities, and Threats (SWOT) related to GIS implementation at the City of Irvine. The SWOT philosophy is defined as:

Strengths

Internal elements that may *contribute* to the successful implementation of a sustainable GIS.

Weaknesses

Internal elements that may *limit* the establishment of sustainable GIS in Irvine.

Opportunities

Internal and external elements that can be leveraged to ensure the success of Irvine's GIS.

Threats

Internal and external obstacles that may *hinder* the success of GIS at Irvine.

The remaining components of this plan should highlight the identified strengths, provide a solution for the weaknesses, take advantage of identified opportunities, and work to negate the identified threats. The following sections highlight the Strengths, Weaknesses, Opportunities, and Threats (SWOT) at Irvine grouped by each of the Six Pillars.

Governance

The following sections highlight the Strengths, Weaknesses, Opportunities, and Threats (SWOT) related to Governance.

Strengths

- GIS team in IT available to assist departments in use of GIS

- Have a lead GIS position for the City (GIS Supervisor). Many cities do not have this position and thus no one that has been given authority to lead a city-wide GIS effort.
- As indicated by the commissioning of this plan, the City has a desire to better leverage geospatial technology. Additionally, the data analysis component of this plan indicates that there is a desire to better organize data at the City and to identify datasets as authoritative to avoid duplication.
- The City has an interest in exploring thus use of GIS technology to better manage and understand data.
- An existing base of GIS users that are interested in expanding the use of GIS.
- A renewed awareness of what GIS can do for the City as a result of this plan.

Weaknesses

- Not everyone realizes how beneficial the technology can be for their department
- Lack of GIS user group whose meetings are key to GIS guidance and employee growth and understanding
- Some departments are not utilizing GIS at all
- Limited expertise in some divisions (backup of work load if one person is unavailable)
- Lack of GIS expertise and understanding in many departments
- The governance model has not been formalized with clearly defined duties and responsibilities for the entire organization in regards to GIS.
- No published annual GIS work plan or goals.

- No alignment study has been created or shared describing how the GIS is aligning and assisting with meeting City goals.
- No clear strategy on what software should be used by whom.
- Lack of a city-wide vision for what GIS data and applications should be shared with the public.

Opportunities

- Greater awareness of spatial information at leadership level
- Better employee understanding of how GIS works and its value
- Better data presentations
- Highlight uses more clearly
- Showcase successes
- Publish white papers of emerging current applications
- Making user group meetings more of a priority
- Creation of a training and education game plan annually
- Creation and sharing of an annual GIS work plan
- Conducting an annual alignment analysis (aligning with City goals)
- Systematic meetings with departments describing how GIS can assist them with their specific needs
- Formalize agreements with Orange County, State of California, and other organizations

Threats

- Potential for lack of support from City Council because they are not aware of what GIS is doing for the City and how it aligns with their goals
- Lack of senior management 'buy-in' because of potential lack of understanding of what the technology can or is doing for their department
- Funding and budget uncertainties as a result of lack of understating of the technology
- Time available/allowed to set aside for GIS improvements or designs
- Stagnation – if importance is not demonstrated, it's forgotten
- Not staying current with other agencies in the area using GIS
- Ensuring that a main focus of the governance strategy is not just the technology but socializing what GIS can do for departments/users/the public

Data and Databases

The following sections highlight the Strengths, Weaknesses, Opportunities, and Threats (SWOT) related to data and databases.

Strengths

- Most GIS data is maintained in enterprise geodatabase system and not residing in various individual departments
- Some key data is being received from Orange County
- Currency/Quality of aerial imagery and LiDAR
- Master Data List exist for core GIS layers

Weaknesses

- Some departments territorial with their data
- Challenging relationship with County Property Appraiser in regards to parcel data updates
- Need a better and more comprehensive master data list
- Lack of a user friendly master data list
- A variety of layers need to be augmented
- Some needed data layers do not exist
- Some data is not being entered into the GIS in a timely manner (i.e. roads and addresses may need to be available before they are actually approved)

Opportunities

- Provide more real-time data
- Creation of new data sets
- Enabling departments to contribute to data update
- More and better data sharing with the public
- Leveraging data with analytical views of key data metrics
- Annual data veracity analysis and study using Esri's Data Reviewer
- Promoting the value and importance of the data the City has created
- Leveraging the wealth of data that resides in the IT systems at the City as geo-enabled GIS layers
- Maintain even more data in enterprise geodatabase system

Threats

- Data loss (redundancy)
- Data timeliness – not having key data when needed
- Bad and incomplete data leading to erroneous decision making
- Lack of understanding of the data maintained by the City leading to lack of use and lack of insight
- Misuse of information (data)
- Lack of understanding of data leading to making bad decisions. I.E. not understanding spatial accuracy of data sets.
- No data maintenance or quality control standards in place

Procedures, Workflow and Integration

The following sections highlight the Strengths, Weaknesses, Opportunities, and Threats (SWOT) related to procedures, workflow and integration.

Strengths

- GIS Technical assistance available
- All departments have access to data
- Some integration with IT systems and GIS data has been implemented (i.e. crime analysis)
- Formal data update procedures exist for some data layers

Weaknesses

- Many related business systems have yet to be fully integrated

- Potential to expand integration not being realized
- Not enough staff and time to analyze and improve processes
- Lack of off-the-shelf integration tools makes integration difficult
- Lack of understating of the importance of IT systems being integrated with GIS leads to duplicative data and data entry

Opportunities

- Greater use/integration to mobile apps
- Implementing software tools to help with integration
- Ensuring that GIS is always considered with the acquisition or upgrade of most City IT systems
- Reduction of duplicative data entry through better integration
- Implementation of tools that allow for integrating feedback from the public

Threats

- Resistance to sharing data/information (potential)
- Lack of good integration tools creating a large workload and complex integration scripts only understood by a few staff
- Changing GIS technology breaking integration

GIS Software

The following sections highlight the Strengths, Weaknesses, Opportunities, and Threats (SWOT) related to GIS software.

Strengths

- Web-based tool for non-GIS professionals
- Adequate GIS software licenses for current usage
- Good access to software
- Relationship with GIS software vendors

Weaknesses

- Collective portal vision team – need user-friendly design skills
- Time to work with departments to identify other opportunities
- Full functionality not available to all users (limited licensing)
- Analysis beyond mapping
- Existing limited GIS licensing does not allow for growth

Opportunities

- Enable every employee with the appropriate GIS tool
- GIS can assist with doing a job faster, more efficient
- More services to the public
- Live-use in public meetings
- More public interfaces or advanced maps for public to access (better sharing of data)
- Work with City Council to analyze their districts
- Additional city/county projects to give citizen a collective not decentralized view

- Private sector business profiles, activities and needs for economic development
- Expansion of analytical tools
- License agreement for GIS software

Threats

- Lack of sufficient web applications
- Lack of mobile applications
- Lack of public portals
- Excess of custom code

Infrastructure

The following sections highlight the Strengths, Weaknesses, Opportunities, and Threats (SWOT) related to information technology infrastructure for GIS.

Strengths

- Sufficient infrastructure with good connectivity internal to buildings and between buildings
- The core GIS team is housed in IT giving them access to IT professionals to assist if needed
- Relational database with administrator support
- Enterprise geodatabase sharing data
- Versioned data editing in the geodatabase
- Technical staff that understand PC technology/server technology

- Have implemented staging and production servers

Weaknesses

- Implementation of ArcGIS Pro will require additional PC resources

Expanded use of field computing will necessitate expanded support Opportunities

- Need for additional equipment for field use of GIS

-

Threats

- Hardware failure or deficiencies
- Lack of hardware replacement inventory and plan

Training, Education and Knowledge Transfer

The following sections highlight the Strengths, Weaknesses, Opportunities, and Threats (SWOT) related to training, education and knowledge transfer.

Strengths

- GIS Day events held annually
- Piqued interest in GIS technology as a result of this plan
- Desire by some staff to learn new technology
- Team of GIS professionals available to do additional training and education

Weaknesses

- Lack of a pervasive training and education plan/curriculum
- Lack of a GIS User's Group
- Lack of socializing GIS and its capabilities throughout the departments
- Lack on internal GIS knowledgebase available to users
- Lack of leveraging social networking tools to promote GIS internally
- Lack of presentations to organizational leaders on how GIS can benefit the City
- Not always clear to departments how GIS would help

Opportunities

- Informal training sessions
- Implementation of a GIS training and education curriculum
- Implementation of GIS users' group
- GIS team meeting with departments consistently about their needs and possible uses
- GIS centric events, such as brown bag lunches, ROI workshops
- Publishing GIS successes

Threats

- Lack of understating of GIS could result in reduction/elimination of the GIS program
- Lack of promotion of GIS successes can lead to lack of understanding and support

- Lack of users' group and other education leads to underuse of data and software
- Lack of GIS staff succession planning can lead to the GIS program threatened due to staff turnover
- Downturn in the economy could lead to reduction in funding if GIS is not fully understood and valued
- Lack of an alignment study with City goals could lead to lack of support and thus lack of funding

Needs Assessment Report

City of Irvine | CA

Table of Contents

- GIS Need Assessment 1**
 - Enterprise GIS Introduction 1
- Existing Conditions..... 2**
 - Overview2
 - Irvine GIS History and Existing Conditions4
 - City Clerk 11
 - Community Development..... 12
 - Community Services 13
 - Great Park 14
 - Finance..... 14
 - Police Department/E-911/EOC 15
 - Public Works 17
 - Transportation..... 18
- Geospatial Needs..... 19**
 - Standard Operating Procedures and Sustainability (Enterprise) 19
 - Have a Deep Bench 19
 - Develop a Relationship with a GIS Consulting Firm..... 19
 - Documentation, Documentation, Documentation..... 20
 - Education and Knowledge Transfer 20
 - Spatial Data Needs Enterprise..... 21
 - City Clerk 21
 - Community Development..... 21
 - Community Services 21
 - Finance..... 22
 - Great Park 22
 - Public Works..... 23
 - Transportation..... 25
 - Public Safety (CAD, Police, and EOC) 25

ArcGIS Hub – Two Way Engagement Solution (Enterprise)	26
The City of Los Angeles, California	28
The California Governor's Office of Emergency Services	28
The City of Brampton, Ontario, Canada.....	28
Public-Facing GIS and Story Maps (Enterprise)	31
Community Development.....	32
Great Park	32
Public Works	32
Transportation	32
Public Safety	33
Automated Data Mining and Integration (Enterprise).....	34
Address Data Management (Enterprise)	35
Intranet GIS Web Portal and Widgets (Enterprise)	36
Metadata and Master Data List (Enterprise)	37
Operations Dashboard (Enterprise)	42
Utilization of Portal Technology (Enterprise)	44
Migration to ArcGIS Pro (Enterprise)	45
Mobile Data Collection and Viewing.....	48
3D Visualization and ArcGIS Urban (Enterprise)	49
Drone imagery (Enterprise).....	51
Training (Enterprise)	52
Geospatial Technology and Smart Urban Areas (Enterprise).....	53
Best of Breed Smart City Examples	54
City of Portland, Oregon, USA:.....	54
City of Las Vegas, Nevada, USA:.....	55
Capital Improvement Program (CIP) GIS (Enterprise).....	55
OnBase/Esri Integration (City Clerk with Enterprise Impact).....	56
Intranet Web Portal (Police)	57
Executive Dashboard (Police).....	59
Story Maps (Police).....	59
Miscellaneous (Police)	60
Emergency Operations Suite (EOC)	60

EOC Common Operational Picture	61
EOC Dashboard	63
EOC Damage Assessment Tools	63
EOC Public Disaster Map	64
Parks Suite (Great Park and Community Services)	66
Asset Inventory	66
Intranet Portal.....	67
Park Locator.....	68
GIS Integraion with CivicRec.....	69
Esri Community Analsyt.....	69
Parks Story Maps	70
Great Park Application	70
Community Analyst (Community Development).....	71
Story Map Comprehensive Plan (Community Development)	73
Crowdsourcing Reporter and Manager (Enterprise).....	74
My Government Services (Enterprise)	75
Economic Development	76
Economic Development Public-Facing Web Map	76
Data Development	76
Economic Development GIS Public Web Portal	78

GIS Need Assessment

Enterprise GIS Introduction

An Enterprise Geographic Information System (E-GIS) is an organization-wide asset and collaborative platform that supports the collection, sharing, and exchange of geographic information. It should allow Irvine staff to visualize, question, analyze, and interpret data to identify relationships, patterns, and trends contained within location-based data. An established E-GIS may contain several hundred data layers in a central repository that represent the collective needs, responsibilities, and considerations of departments throughout an organization.

E-GIS technology can support many diverse functions including, but not limited to, asset and capital project plan management, planning, public safety, managing parks, managing utilities and infrastructure, and a host of other department-specific duties. E-GIS is a key enabler of map production and other location-based information tools that can be provided to staff, contractors, stakeholders, and the general public, all of which are derived from information stored and managed in enterprise geo-databases that support the E-GIS and related systems.

GIS technology facilitates data-driven decision making, playing a key role in strategic service management and tactical service delivery. GIS is an integral component of computerized maintenance management systems (CMMS), work order management systems (WOM), public safety systems (911, RMS, and EOC), and an array of other information technology (IT) systems used throughout Irvine.

Sustainable E-GIS at Irvine requires a considerable amount of discovery and deliberation. A documented assessment of existing conditions is a logical first step, as it allows for informed decision-making regarding the needs of each operating unit and the organization as a whole. This chapter focuses primarily on the discovery and documentation of the various geospatial needs of the City of Irvine.

Existing Conditions

Overview

The following sections document the needs identified during preliminary phone calls, data gathering, the on-line voice of the customer survey, and on-site interviews with key staff in several departments. The interviews took place at the City of Irvine, California, in February 2019. Included in the Needs Assessment interviews were the departments and divisions of:

- Chief Information Officer
- Community Development
- Community Services
- Finance
- GIS
- Public Safety/CAD
 - Crime Analysis
 - Emergency Operations Center
- Public Works
- Records
- Transportation

The Enterprise GIS Strategic Plan and Data Management Plan Working Group interview schedule was as follows:

Date/Time	Department	Attendees
Monday, February 11th		
9:00 – 11:00	Kick-off Meeting	Department Representatives
11:00 – 12:00	Public Works/Lucity	Julie Bott, Vien Nguyen, Anna Sanchez, Laura Rivera, Jack Balta, Bryce Agnew
1:00 – 2:00	Community Development	Victor Kao, Joel Belding, David Law, Roger Carton, Cassi D. Palmer, Linda Vo, Bill Jacobs, Claudia Landeras-Sobaih, Marika Poynter, Melissa Chao, Diane Vu
2:00 – 3:00	Records	Debbie Tracy, Taryn Tang, Daniel Kim
3:00 – 4:00	Crime Analysis	Lorie Velarde, Darcy Jones, Rebecca Woolsey
Tuesday, February 12th		
8:00 – 9:00	Chief Information Officer	Khaled Tawfik, Michael Sheeran, Rebecca Bridgeford
9:00 – 10:00	Transportation	Eunise Reynon, Peter Anderson, Mike Davis, Rebecca Bridgeford
1:00 – 2:00	Community Services	Jenn Starnes, Kelly Feldman, Darlene Nicandro, Amir Dorosti
2:00 – 3:00	Public Works	Scott Smith, Jim Houlihan, Pamela Baird, Doug Kind, Sona Coffee, Dennis Chiotti, Joe Dillman, Michael Morgan, Steve Sherwood, Julie Bott, Vien Nguyen, Anna Sanchez
Wednesday, February 13th		
10:00 – 11:00	Public Safety/CAD	Lindsay Crawford, Lindsay Hanania, Dennis Hernandez
11:00 – 12:00	Public Safety	Jeff van der Sluys, Mike Fender, Rebecca Bridgeford
1:00 – 2:00	EOC	Robert Simmons, Dennis Hernandez, Jade Mazzio, Michael Sheeran

Irvine GIS History and Existing Conditions

At the City of Irvine, Geographic Information Services (GIS) is a section of the Information Technology Division of the Human Resources and Innovation Department. The GIS Section serves all City Departments and the residents of Irvine and participates in all GIS initiatives city-wide. The section manages and maintains data with the goal to collect, analyze, and disseminate city-wide geospatial information.

The City of Irvine started using GIS in 1989. In order to expand the GIS function toward a true Enterprise GIS, the City contracted with Esri in 2003 to conduct a GIS Needs Assessment and prepare a GIS Implementation Plan. In 2017, the GIS section was moved from the Community Development Department to the Technology Division in the Administrative Services Department to streamline budgeting and accountability for IT services. In 2018, Irvine commissioned Geographic Technologies Group (GTG) to prepare this Citywide Enterprise GIS Master Plan and Enterprise Data Management Plan, with the goal of identifying a clear roadmap to improve and optimize data and to use geospatial technologies to their fullest. In Q4 2018 the Technology Division, including GIS, joined Human Resources to become the Human Resources and Innovation Department.

The core GIS team enables departments to utilize GIS through the provisioning of software, data, and technical support. The GIS section in IT is comprised of four full-time positions, one part-time position, and interns. The team provides GIS administration and coordination, data management and storage, and web and field mapping support for departments throughout the City who use GIS to support their daily tasks and operations. In addition, the GIS staff coordinates efforts with the City Council, local and regional government organizations, and Orange County in regards to the optimization of GIS efforts, data sharing, and thought leadership.

The GIS Section in IT is responsible for the following key functions:

- **Support of internal and external customers through the use of the Esri GIS platform and integrated business systems;**
- **Innovation of new and existing technology in an effort to improve communication, efficiency, and data sharing;**
- **Forming strategic partnerships with city, county, regional, and state agencies, including Irvine Unified School District and Orange County Fire Authority;**

- Providing GIS services and maps to staff in any City department on an as-needed basis;
- Maintaining a central GIS database, software, and applications (internal & external);
- Controlling GIS license purchasing, maintenance, and allotment;
- Maintaining critical base data layers:
 - Address Points
 - Street Centerlines – including street naming and address approval process
 - Building Outlines/Footprints
 - Parcels
 - Aerial Photography

Existing Software

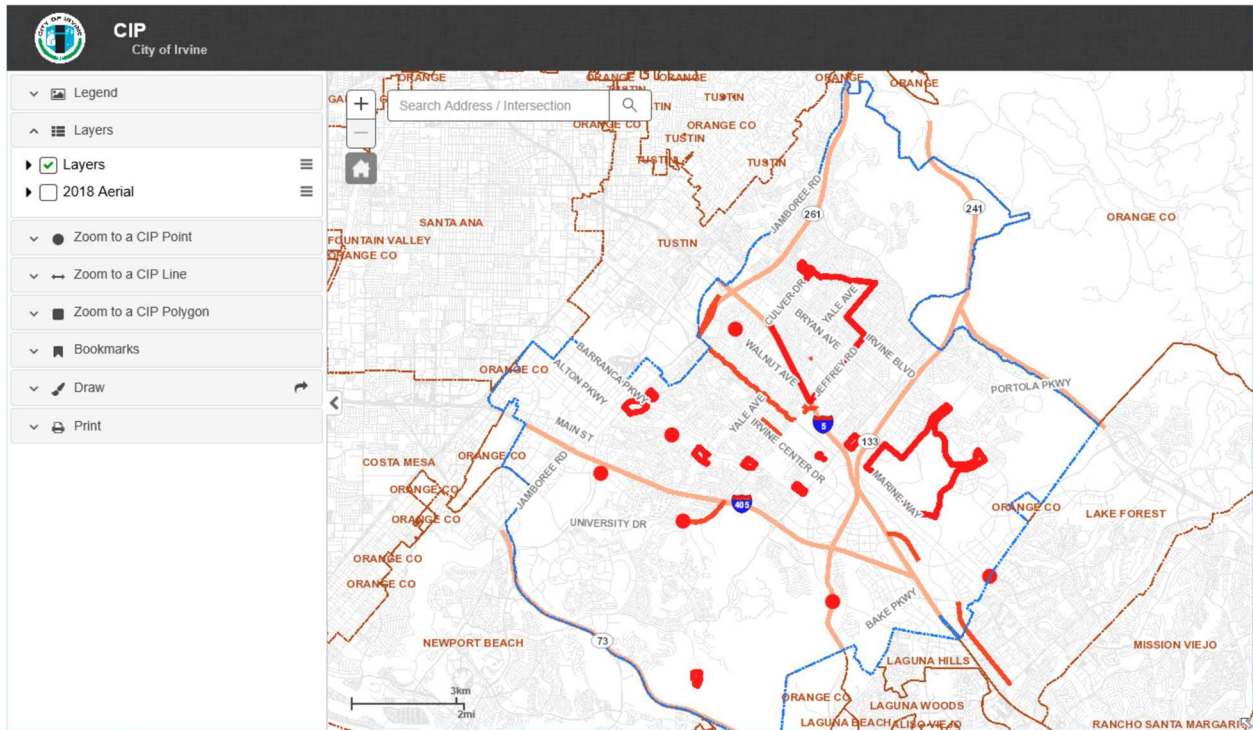
The primary GIS data maintenance and analysis software application used at the City is Esri's ArcGIS Desktop. ArcGIS is used by the GIS section analysts for updating data layers, creating and updating map services, and producing cartographic quality maps. Users throughout the City with ArcGIS Desktop have read access to the enterprise geodatabase. These staff are using ArcGIS Desktop for viewing and analysis.

There are more than twenty internal GIS web applications that provide access to critical layers for the City staff (sites available only inside City firewall <http://coi-gisweb-pv>). Some of these applications are listed below:

- **Online Parcel Viewer** – Generic application used by all city departments to display GIS data
- **City Map Services** – Library of current GIS Services available
- **CIP Viewer** – Used by Finance Department to view, identify, and display Capital Improvement Program projects

- CIP Editor – Used by Finance Department to edit Capital Improvement Program web app
- Conflict of Interest – Used to identify possible Conflicts of Interests of City Council, Commissioners, and select City employees
- CS Open Space (Community Services) – Displays City administered Open Space with deed or ownership transfer information
- Geopolice Viewer – Displays Police Emergency Service Zones and beats
- iGrade Citywide – Displays various grading sites along with permit information
- iWho AS – Seating chart and phone directory for Administrative Services Department
- iWho (Community Development) – Seating chart and phone directory for the Community Development Department
- iWho City Hall (Excludes Public Safety) – Seating chart and phone directory for most of City Hall
- Landscaping Viewer – Displays various GIS Layers used by Public Works for Landscaping purposes
- PA 51 Web map – Displays various GIS layers available specifically for Planning Area 51 of the City's General Plan and the Orange County Great Park (OCGP)
- Parking Variance – Used by Public Safety to mark and display parking conditions
- Road Construction Editor – Displays Police Emergency Service Zones and beats
- Speed Trailer Editor – Displays current locations of City Speed Trailers
- SIP Editor – Editable Street Improvement Plan website
- Storm Drain Editor – Displays City Storm Drain location and information
- Street Maintenance – Displays GIS layers relevant to Public Works Street Maintenance Staff
- Tracts – Displays Tentative Tract layer

- Tracts Editor – Editable Tract application used by the Community Development Department
- County Address – Displays possible Orange County addresses anywhere in the City
- Monuments Viewer – Displays location and type of City monuments



CIP Viewer intranet web map

The GIS section also has developed several interactive websites and digital maps available to the public through the Irvine GIS web portal. These applications use Esri's ArcGIS Online as the core technology. (See <http://gis.cityofirvine.org/irvinegis/index.html>.)

- Public Online Parcel Viewer – allows the public to look up an address, parcel map, general plan, zoning, street sweeping zone schedules, flood zones, imagery, and more
- Centerline Ties – Map of all surveyed lines which determine the center of intersections, with links to original documents
- Bikeways – Displays bike paths in Irvine and surrounding cities

- Street Improvement Plans – Show Street Improvement Plan and links to related documents
- Road Construction – Displays regularly updated road closure and road construction location and information
- City Parks – Displays location and amenities for all City Parks
- Open Space Deeds – Displays City administered opens space with deed or ownership transfer information



Irvine GIS Interactive Maps

Existing Spatial Database

The City currently has a central repository for most geospatial data, an Esri enterprise geodatabase on SQL Server 2016, which is administered by the GIS section. This versioned geodatabase is used primarily for core data layers, administrative boundary layers, and some transportation and environmental data. ArcGIS Desktop (ArcMap) is used by the GIS analysts for data updates and map service management. There are also some assets stored as features in a Lucity asset management system geodatabase. The GIS section has complete access to this geodatabase and performs some management of the features.

The GIS section staff manages and maintains the critical geodatabase layers. Currently, there are over 360 data layers in the geodatabase. Critical base layers include the following:

- **Land Parcels – 45,731 parcels**
- **Building Addresses – 81,265 addresses**
- **Street Centerlines – 8,281 segments**

Background - Existing Core Data Layers

In the context of geospatial technology, a *data layer* is the visual expression of accumulated data of a particular type. Critical data layers refer to the data layers that are central to the GIS initiative. A more in-depth data assessment document and study are included in this project. The below is intended as a contextual overview to lay the groundwork for this Needs Assessment.

Parcels

A parcel is a legally defined area of land; a cadaster is a comprehensive land recording of all real property boundaries. In GIS terms, a parcel layer is the digital representation of the cadaster within the jurisdiction.

Currently, the City is using parcel maps provided by Orange County. Newly recorded parcels are received from the County through Public Works. Those received in AutoCAD

format are converted into GIS format. Adjustments are made in the exported GIS shapefile and later copied into the production parcel layer where attributes are added.

Address Points

An *address point* is a location marked by its position relative to a roadway. An address point is not necessarily the same as a street address. It is a data-point assigned to a mapped location according to parameters that may or may not coincide with a street address.

GIS maintains the address point on the commercial building centroid or residential parcel centroid as plats are received for new parcels. The land developers are responsible for devising the address plan for their plats, which are then approved by the County planning, public safety, United States Postal Service, fire, and GIS departments. Efforts are underway to receive most plats in digital format, as early in the development process as feasible. Most departments expressed issues with the timing of address availability and the completeness of this layer.

Street Centerline

The *street centerline* is a linear data layer that correlates to a center of the roadway and has attributes for street name and address ranges. This base layer is considered critical for address lookup and reference in nearly every application.

New recorded parcel tract lines are used to generate street centerlines. They are copied into an intermediate line layer, where errors are fixed and adjustments are made. The new centerlines are then copied into the production centerline layer in the central geodatabase and attributes are updated. A GIS analyst from the GIS team is on an Address and Street Naming Committee at the City of Irvine. Irvine has a published addressing guide.

Aerial Photography

Aerial photography describes birds-eye-view style photographic data gathered from a plane, drone, or helicopter-mounted camera. Because aerial photography produces an actual image of the mapped terrain, it improves the comprehensibility of practical details.

Aerial photography is purchased annually from Eagle Aerial. The GIS section houses over 200GB of image files for years 2000 through 2018 (and 1976, 1986, 1992). LiDAR has also been collected, which is used for the Great Park Initiative.

The following are the general conditions in regard to geospatial usage for each of the departments interviewed.

City Clerk

The City Clerk is responsible for the administration of democratic processes such as elections, access to City records, and all legislative actions under consideration or enacted by the City. The City Clerk also acts as a compliance officer for numerous federal, state, and local statutes including the Political Reform Act, the Brown Act, and the Public Records Act. Departmental staff in the Office of the City Clerk carry out this mandate through the following actions which include:

- **Ensuring that the legislative process including City elections as well as City Council and Commission meetings are open and public;**
- **Reporting and preserving the legislative history of the City efficiently and accurately;**
- **Providing access to complete and accurate public information and official records;**
- **Promotion of voter registration and electoral process participation through non-partisan public outreach.**

The Departmental Records team has eleven (11) personnel that are responsible for storage, management, and retrieval of documents and records for City staff and the public. OnBase from Hyland Software has been implemented on premise as the enterprise electronic content management (ECM) solution to support departmental document storage, management, and retrieval workflows. OnBase supports integration with a wide variety of other Enterprise Information Systems through several applications program interface (API) toolkits. An OnBase API integration toolkit has been procured but has not been implemented at the time of this writing. The OnBase Esri integration Toolkit has been purchased and a kick-off meeting has ensued. Several departmental groupings have been setup within OnBase. Several document types captured in the OnBase platform are available for reference through the City GIS at this time. These include street improvement

plans, city owned parcels, and centerline ties. Every department expressed the desire to have a GIS link to OnBase.

Community Development

The Community Development Department has a staff complement of 65 personnel and is made up from several divisions including the Development Services Division, the Building and Safety Division, and the Neighborhood Services Division. The Development Services Division develops and implements the policies and objectives of the community as set forth in the City of Irvine General Plan and Zoning Ordinance. This division also reviews proposed developments for consistency with the City's standards and policies relating to land use and preservation of the environment. This division is also responsible for park planning, long range planning, and regional and interagency coordination. The Building and Safety Division seeks to protect and enhance the physical environment by ensuring that all construction within the City complies with adopted codes. The Division also works to ensure that permitting systems are efficient and meet the needs of the public.

The staff of the Neighborhood Services Division is responsible for implementing the City's Housing Strategy and Implementation Plan and Inclusionary Housing Ordinance together with the federally funded Community Development Block Grant (CDBG) and HOME Investment Partnership Act (HOME) entitlement programs. Staff in the division respond to code enforcement concerns pertaining to violations of the City of Irvine Municipal Code, which includes building, zoning, sign, grading, noise, and encroachment regulations. Neighborhood Services staff are actively involved in ensuring that residential properties are safe and sanitary and make loans or grants available through the Residential Rehabilitation Program to assist homeowners in need of health and safety, building code, and accessibility related repairs. This Division also maintains updated information on local developments that offer affordable housing.

The department has implemented location-based information technology to serve a variety of needs including StoryMaps for notable development projects, Conflict of Interest web map for planning, and the custom CDB application built and maintained by Critigen to account for and manage the number of vehicle trips allowed per zoning area. Approximately 30 departmental staff use this platform at the time of writing. A web mapping technology application is in production to serve some data viewing needs. Field inspection staff use

mobile devices to access the Eden permitting system which is underpinned by an instance of ArcGIS for Server. One planner currently uses ArcGIS Desktop for the development of presentation graphics. Management of departmentally-focused GIS data layers is provided by the GIS team that is situated in the IT Department. Several GIS datasets are used to track best management practice indicators for water quality. A GIS layer is also used to track the location of established Home Ownership Associations (HOAs). A series of map books produced by the GIS team are provisioned to inspection and damage assessment personnel.

Community Services

The Community Services Department is the most public facing of all City departments. They are responsible for a wide array of services and facilities for residents and visitors to the City. Their responsibilities include class registration; facility reservations; family, teen and child services; athletics, sports and aquatics; camps, classes, and activities; and fine arts. Their diverse services also cover a no-kill Animal Care Center, Disability Services, Military/Veteran Services, Senior Services as well as parks and facilities, open space/trails, two Aquatics Centers, and the Irvine Fine Arts Center.

Community Services operates 22 community parks, 41 neighborhood parks, and the Orange County Great Park. There are also several other regional and county parks within the city limits. The City also owns a number of open space and HOA park parcels throughout the City.

The department uses cloud-based CivicRec software from CivicPlus® for all activity registration. Participants in the child development, teen and senior programs are also entered into CivicRec. The platform includes an administration interface for staff and public-facing recreation registration software. Residents and non-residents register for activities on <http://www.yourirvine.org/>. (See <https://www.civicplus.com/civicrec/recreation-software>.)

The department also takes reservations for fields, community centers, and other facilities. To date, the system has approximately 25,000 individual and family accounts and organizations.

The department uses the Routematch software platform to connect Irvine seniors and adults with disabilities with paratransit transportation service. Part of the registration process is a check of whether the registrant lives within the city limits of Irvine. (See <https://www.routematch.com/>.)

Irvine GIS produced two web portals for Community Services. The one for Open Space Deeds is used by the department staff to view the open space boundaries as well as state, federal and BLM properties boundaries. The City Park Locator web app contains city parks, Great Park Facilities, and trails; however, the Community Service staff believe this data to be out of date. (See <http://gis.cityofirvine.org/irvinegis/interactiveMaps.html>.)

Great Park

The City of Irvine-owned Orange County Great Park lies on a section of the former Marine Corps Air Station El Toro. The Great Park is an art and sports recreational hub. It spans approximately 1,300 acres and attracts many visitors to its growing list of amenities, such as a new Sports Complex, Palm Court Arts Complex and Great Park Ice.

Residents can rent one of three sites at the OCGP through a web portal <http://rent.ocgp.org/>. The Balloon Park, Festival Site and El Toro Field have facilities and amenities for large events and filming.

The Great Park is staffed by employees from Community Services, Public Works and some contract staff. The Great Park maintenance staff use the City's GIS system to draw layouts and save them using the drawing/layout tool box; however, one drawback is that they can only measure a few things at a time. The City has also recently acquired LiDAR for the Great Park area for planning, development and maintenance purposes.

Finance

The Finance Department responsibilities are to record transactions, reconcile transactions, make payments to vendors, send invoices to customers, issue bonds for new development, and any other finance related tasks. All information is recorded in Central Square software.

The department's staff consists of 25 people including a Supervisor of Accounting Services and a Senior Accountant.

The department must produce maps for new Community Facilities Districts (CFDs) and does so with the help of the Irvine GIS staff. There are currently four CFDs, as well as 13 Assessment Districts. Property ownership which could represent a Conflict of Interest for City Council members is checked by Finance on the intranet to determine whether a proposed project is near a property owned by council members.

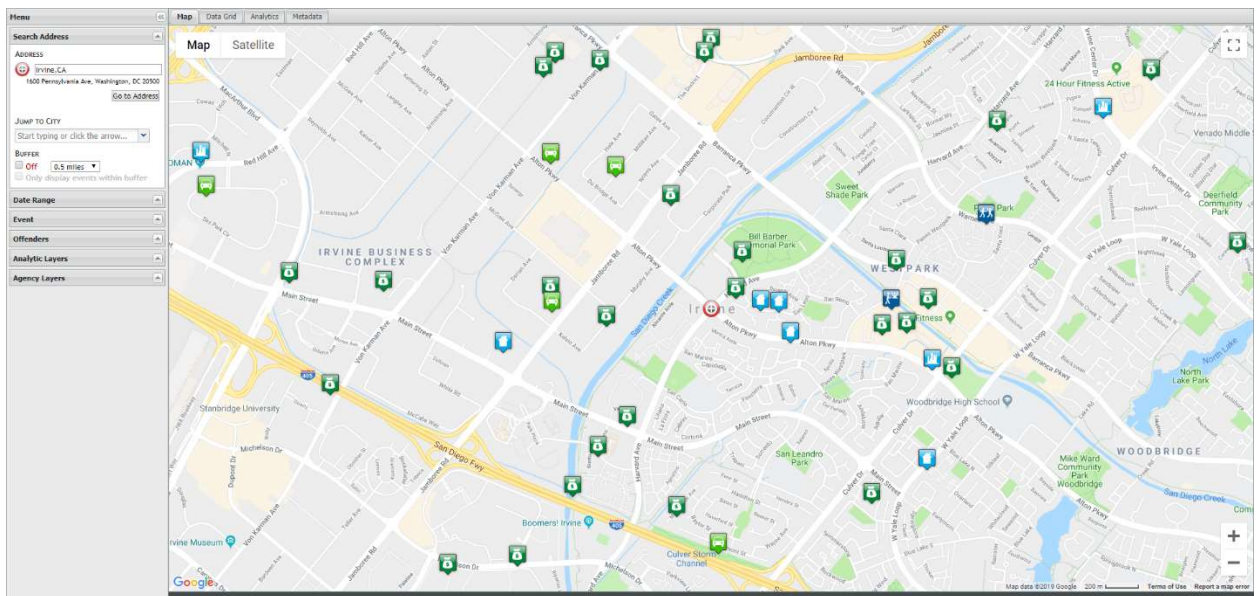
Police Department/E-911/EOC

The Irvine Police Department is an advanced user of geospatial technology. Spatial/location information is critical to public safety. Most of the information processed by the Police Department has a geographic component. E-911 calls must be geo-located. E-911 calls and reported incidents are all tied to a location (cell phone location, address, or intersection). Emergency Operations plans for and responds to emergencies which have a host of geographically related components. In that regard, the Police Department uses GIS extensively today.

The E-911/CAD system is from Intergraph. Intergraph uses proprietary mapping components that do not use Esri GIS files natively. This requires that the City's Esri data is converted to a format that is compatible with Intergraph using conversion and upload tools. This means that the data is never live. The City has begun to explore a new E-911 dispatch system, which if pursued will take multiple years to acquire and implement. No optimal routing of vehicles is done with the current E-911 system. Many of the 911 call locates are being located to the street centerline instead of the address points on top of the unit. E-911 dispatches for City Animal Control and Police-related calls. Vehicles are equipped with automated vehicle location (AVL) technology and the vehicle locations can be viewed in the 911 system. Officers report they are using commercially available mapping systems like Waze to get optimal routing and traffic information and do not rely on the mapping from Intergraph.

The Police Department has advanced GIS users focused on crime/incident analytics. Two crime analysts and one GIS analyst use geospatial and other analytical software for mapping incidents and analyzing spatial patterns. They access data directly from the SQL tables from which they create reports and do queries. Python scripts are used to extract data that is then used within ArcGIS for mapping purposes. Anywhere from 5 – 10 percent of the data from the 911 system is not being geo-validated. PDF maps are provided to the patrol officers weekly (i.e. breaking and entering). Other analytics/mapping are performed on a regular or as-needed basis (i.e. traffic collision information). The team uses a variety of spatial software to include ArcGIS, Esri Spatial Analyst, GeoTime, Rigel, CrimeStat, and Lexus/Nexus (old Bair Analytics). Crimemapping.com is used to push incident data to the public and is generalized by area. Google maps are used frequently for logistical support. The team creates their own sex offenders and warrants layers as needed. Parolee data is acquired once a month from the state. The Police Department uses beats and report districts for their geographic areas. They are balanced approximately once every five years using GIS tools.

The Office of Emergency Management is responsible for coordinating the training, planning, and management of major emergencies or natural and man-made disasters which all are inherently geospatial in nature. The City uses WebEOC software for disaster management which has a data viewer. A citywide workgroup meets for EOC scenario drills. Flooding is a concern, as the city has four dams that would inundate areas in case of failure. Fire behavior modelling is conducted along with the Orange County Fire Authority. Hiperwall video wall software is being used for command center control.



Public Works

The Public Works Department develops, builds and maintains the City's infrastructure including streetscapes, open space, City parks, athletic fields, trees, bike trails, roadways, traffic signals and more. For the purpose of this plan, interviews were held with representatives from Development Engineering, Facilities Maintenance and the Public Services divisions.

Public Works uses Lucity for work orders and asset management. Public Works documents are managed in [OnBase](#), by Hyland Software, with a wealth of information on easement documents, agreements, reports, etc. The current implementation of OnBase does not have a GIS connection.

Development Engineering is responsible for Capital Improvement Project (CIP) design and Right-of-Way plans for the CIPs, and for all construction in the public right-of-way. Development Engineering is also responsible for all subdivision processing. CAD drawing files are also received for road designs and as-builts, according to their CAD standards. This information is not currently being used to update the GIS data.

The Facilities Maintenance division is responsible for the indoor and outdoor maintenance of 116 City sites, including community parks, pump stations, neighborhood parks, trails, bridges and special facilities such as the Irvine Civic Center, Child Care Center and the Animal Care Center. They handle such tasks as lighting, graffiti removal, sports equipment repair, and general building maintenance. The division also manages the Pest Management Program and reports pesticides use to the county. There is no use of mapping for where pesticides are used on City parks, fields, playgrounds, street medians, buildings or other city properties.

The Public Services – Street & Right-of-Way Maintenance division is responsible for maintaining roads, sidewalks, and signs. This division has a mapping-grade right-of-way layer and oversees the use of PAVER software, which is not currently linked to GIS. They also manage Street Sweeping programs. Pavement markings and signs have been inventoried through [Transmap](#) and are also available through Lucity; however, this dataset is not up to date for the recently constructed streets and is lacking warning sign inventory. Also, the Public Drainage Program is responsible for the maintenance and upkeep of City

public drainage facilities. They use the storm drain and drainage facilities layers to help in the management of all storm water infrastructure in the City.

The Public Services – Fleet Services division is responsible for maintenance of the City's fleet of vehicles and heavy equipment as well as the fuel depots. Most of the City's vehicles have AVL tracking devices installed.

The Public Services – Landscape Maintenance Division maintains over 1,000 acres of parks, greenbelts, street landscapes, and landscaped facilities. The Division also maintains over 70,000 trees. The City is charged for water based on topology, but they report that the current data is not useful for this purpose. There is a web map of City Landscaping (accessed through a link on the division's web page), but the map does not appear to be populated with the landscape maintenance areas. (See [http://gis.cityofirvine.org/city_landscape/.](http://gis.cityofirvine.org/city_landscape/))

Public works has just recently started using GPS devices in the field to acquire the location of assets like city maintained hydrants, signal poles, park furniture, playgrounds, etc. These features are being stored in a spatial database that will link to their Lucity asset management system to assist in work order creation and asset management.

Transportation

The Transportation Department oversees all facets of transportation management, including traffic management and transit planning.

Most of the 19 Transportation staff use GIS to look up property ownership and record data on the intranet site. They are also tasked with uploading any project to the GIS supporting CIP map from information supplied by the divisions. They previously used ITrack for traffic management, but it has been migrated to GIS using their template.

The department is transitioning to TransCAD for Forecast and Analysis. They continue to interface with land use inventory and other items in the City's centralized database. Their users include four modelers and two editors in traffic management.

Irvine GIS produced several web portals for Transportation/Public Works – Bikeway Map, Street Improvement Plans and Road Construction.

Geospatial Needs

The following section describes needs discovered during the interview and recommendations for expanded GIS use based on best practices. These needs may be software, technology, or process related. In the title bar, the need is identified. Additionally, the department or department that has this need can be found in parenthesis. If the need affects all departments or a majority of departments, it is labeled as an enterprise need. The leads are not listed by any type of priority.

Standard Operating Procedures and Sustainability (Enterprise)

GIS is an enterprise asset that has become indispensable for departments and the organization. However, its indispensability does not guarantee its permanence and sustainability. Due to budget constraints, lack of visibility, lack of education, and/or other factors, some organizations have found their GIS budgets shrinking. In extreme cases, GIS programs have failed and been abandoned. This strategic plan has identified the desire and needs for expansion of GIS throughout the organization and to external customers.

What can Irvine do to safeguard their GIS investment and guarantee sustainability? One key strategy is a focus on succession planning. Some organizations have seen their successful GIS program digress when a key staff person leaves the organization.

A few of the key elements to ensure the sustainability of the GIS program are as follows:

Have a Deep Bench

Ensure that the GIS program is fully staffed with various levels of GIS expertise. Staff needs to be cross-trained as much as possible. This will allow a qualified candidate to step up to fill the void created by a key staff person leaving and a replacement is hired.

Develop a Relationship with a GIS Consulting Firm

Another strategy is to have an ongoing relationship with a GIS consulting firm that can provide experienced personnel on a temporary basis until a key vacated position is filled. Additionally, the consulting firm can assist with key projects. It is unreasonable to believe that internal staff can do everything that is needed for an enterprise-wide program.

Progressive GIS programs use a mix of internal staff and external GIS experts. Additionally, using an external GIS expert guarantees a different perspective. Many organizations do not achieve full enterprise-wide GIS usage because they become slaves to what they know. They develop a comfort level around this knowledge base and in extreme cases, fight to preserve older technology because that is where they are comfortable. It is recommended that Irvine maintain a long-term relationship with a consulting firm to ensure that different perspectives are considered. Additionally, this plan recommends a number of ongoing mechanisms that ensure enterprise-wide success to include an annual voice of the customer survey, presentations to decision makers, an annual update to the plan, and various other checks and balances. Geospatial technology has become too pervasive to only include the perspective of a few GIS gurus in the organization.

Documentation, Documentation, Documentation

Many organizations have found themselves having to start over upon losing a few key staff persons. In these cases, the departing staff left no documentation and no instructions for their replacements. This resulted in a chaotic situation in which there was no way to accurately identify the organizational GIS assets. Undocumented scripts, data, and software assets have led to many organizations having to pick up the pieces and begin anew. Irvine has done a limited amount of documentation for some of its GIS operations. However, key SOPs are missing and should be documented, organized, and shared with all of Irvine GIS staff. The IT GIS team should focus on documentation of assets and build a library of SOPs that would allow new staff to move forward with little disruption in services.

Education and Knowledge Transfer

Often, organizations find great success with GIS, but do not educate the organization about these successes. This plan identifies a number of education items that are instrumental to the sustainability of GIS. This includes documentation and dissemination of return-on-investment examples, education opportunities for all staff, elected officials, and the public, as well as, leveraging internal and external media opportunities (television, newspaper, social media, etc.).

Strong leadership and guidance from a GIS steering committee will ensure that GIS is aligned with the overall goals, priorities, and mission of Irvine which, in turn, will be instrumental in ensuring continued GIS success.

Spatial Data Needs Enterprise

Irvine has a wealth of geospatial data; however, each of the departments interviewed identified additional data needs. Some of the data may already exist and just require some refinement. Other data may exist, but not be accessible at this time. In some cases, integration may be needed, and other times a different tool.

One of the prevalent data needs was the further refinement of the address point layer to a) have a point on top of every unit in a building and b) get the information quicker even before final approval. An entire chapter will be dedicated to the topic of Irvine's data needs as part of this plan. Below are some of the data needs expressed by the departments interviewed.

City Clerk

- Improved linkages between OnBase and GIS
- Smart Trash Cans IoT

Community Development

- The establishment of specific quadrants for Code Enforcement cases
- Contaminants and other issues of concern within Great Park
- Accessory dwelling units
- Business licenses by pending, approved, denied
- Documenting a formal process to buffer structures that have applied to be approved for cannabis was requested to help ensure that approval is not given if the site under consideration is too close to a licensed daycare.

Community Services

- City Owned Lands Acreage
- Authoritative Number of Parks and Acreage
- Quick access to an authoritative layer of what is inside or outside of the City limits
- Location and Access Points to Restoration Projects
- Layer of capital improvement projects (Past, Present, and Future)

- Park ownership (HOA or City Owned)
- Mapping of park customers (online registration system)
- Park boundaries (22 community and 41 neighborhood parks)
- Open space acreage information
- Detailed infrastructure assessment of Great Park
- Data from the Chameleon database (animal control data)
- Mapping of data from Route Match software showing the location of special needs residents
- Indoor LiDAR of the great park facilities
- Detailed map of large festivals
- Detailed information about each trail
- Regulatory layers (for building new facilities)
- 3D park layer
- Memorial park bench locations
- Park infrastructure

Finance

- Community Facilities District and Assessment Districts
- Various utility layers
- City Meters, Electrical Meters
- City Property Leases
- Fixed asset locations
- Easements
- Additional parcel information (liens, assessed value, owners, etc.)
- City-Owned Property

Great Park

- Full detailed inventory of all assets and facilities
 - Cable run outlets
 - Electric
 - Outlets
 - Loads

- Roads
- APNs for all acreage
- Water
 - Identifying potable vs. non-potable
 - Sprinkler systems
 - Irrigation hook ups or shut-offs
 - Hose bib hookups
- Park Assets for Facility Maintenance
- Landscaping layer (Public Works)
- Parking
- View location of Great Park users (CivicRec)
- Fire access locations
- Wildlife Corridor (mountains to sea)
- Cleveland national forest layers
- 3D view of the stadium and other key buildings
- Lucity work orders within the park
 - Quickly identify a problem
- Method of providing data to Google

Public Works

Overall at least 20% of the City infrastructure needs to be field surveyed (on foot) with the other areas collected via vehicles. Need a full update of assets tied to Lucity.

- Inventory of Signs (outdated)
- Work Order locations (from Lucity tied to assets)
 - Asset Management
- OnBase data
- Capital improvement project locations
- Landscape areas
- Easement locations

- Sidewalks
- Storm drainage
- Good trail data
- Solid waste facilities and recycling stations
- EV structures
- Integrated pest management map of areas that are treated
- Green cover layer
- Solar feasibility layer
- Facilities maintenance data (full assessment)
 - Backflows
 - Underground pipes
 - Water fountains
 - HVAC
 - Sports facilities
 - All park infrastructure
 - 7500+ light poles
- Infrastructure locations
 - Irrigation
 - Trees (currently have this and maintained by a consultant)
 - Medians
 - Pavement markings (have a layer but not updated)
 - Etc.
- Integrated pest management (IPM) location data (when sprayed)
 - Currently in Excel
- Signals and Boxes
- Streets
 - Maintenance agreements tied to them
- Detailed Peter's Canyon data

Transportation

- Sidewalk Inventory
- Bus Stops and Amenities
- Bike trails and restrooms
- Bike shops
- Ridership Counts
- Current Projects
- Transit Routes
- Traffic Management and Control - Signals, Stop Signs
- Sign Inventory including Trail Signs
- Pavement Information
- Intersection and Road Way Lane Deployment
- School Zones
- Traffic Accident and Incident Data
- Mid-block range geometries- medians (i.e. two way turns)
- Incident management data
 - Street and lane closures
- Roadway moratoriums
 - Permits coming up
 - What has been accepted by the City
 - Right-of-way restrictions
- Electric Vehicle Charging Station Locations
- Signal modifications
- Bike and pedestrian counts
 - Have the data needs to be mapped (bikes, heads, cars) for every major intersection
- Map out the existing database of future anticipated roadways and roadway improvements

Public Safety (CAD, Police, and EOC)

- More robust address layer with suite numbers
- Traffic Flow Pattern and Volume
- Apartment Communities Downtown
- Cameras - Civic Center, Great Park, Intersections
- Underground Infrastructure
- Jurisdictional Boundaries
- Community Crime Map
- Hazard Mitigation Plan
- Irvine Ranch Water District Data
- WAZE Data
- Geocoding of animal control cases
- Viewshed data for snipers
- EOC related data
 - Real time data in any form
 - Evacuation zones, evacuation management
 - Evacuation routes
 - Handicapped residents
 - Schools
 - Shelters
 - Critical infrastructure
 - Debris management.
- Pre-Plans
- Census and Demographic
- Electric Data

ArcGIS Hub – Two Way Engagement Solution (Enterprise)

Data created and maintained by Irvine is a public resource and should be released to and leveraged in service of local residents, businesses, and institutions. The City's open data program should be a set of policies, processes, and technologies for maximizing the value of the City's data while simultaneously maintaining the highest possible degree of protection for privacy and security. The City has some mechanisms in place today (City

Council Resolution 13-50) for cost recovery for time and materials which should be reviewed before an open data initiative is launched.

Business units and departments across the organization have expressed needs for collaborating with each other, with external entities, and with the public. These needs span sharing data, maps, reports, photos, and drawings.

Several departments stated the need for access to project documentation from all groups, departments, and external agencies for regional project planning and group project coordination. Document types include concept, design, preliminary plans, research, documents, reports, and as-builts. A comprehensive project location map app on a portal could show not only the project sites but also their status with links to all project documentation.

Multiple groups identified datasets which could be shared internally and externally with other agencies, departments, contractors and external entities. Irvine should consider transforming the way data is disseminated by building a collaborative GIS Hub, the step beyond Open Data, where maps, apps, and data reside together in one place for staff members, contractors, agencies, and the public to access and provide feedback for Irvine's location-based data through an online hub.

Esri's ArcGIS Hub is a bridge between Irvine's departments and the community. The foundational GIS work, done by internal departments, will help the entire community collaborate on projects. A Hub can combine Irvine's geographic data into a location-as-a-service platform (LaaS), offering authoritative information, insight, and a means for stakeholders to collaborate to address goals, initiatives, and challenges.

Available Hub components include:

- **Open data – searchable by category**
- **Story Maps**
- **Maps and apps**
- **Dashboards**
- **Initiative templates, configurable as needed**
- **Public user accounts for collaboration and sharing**

Several apps and maps were identified as needs that could be added to the Hub for use by internal and external staff members. Several government agencies have already invested in and deployed Esri's ArcGIS Hub, under various local names, as a part of their commitment to becoming smart communities. A few of these examples are documented below:

The City of Los Angeles, California

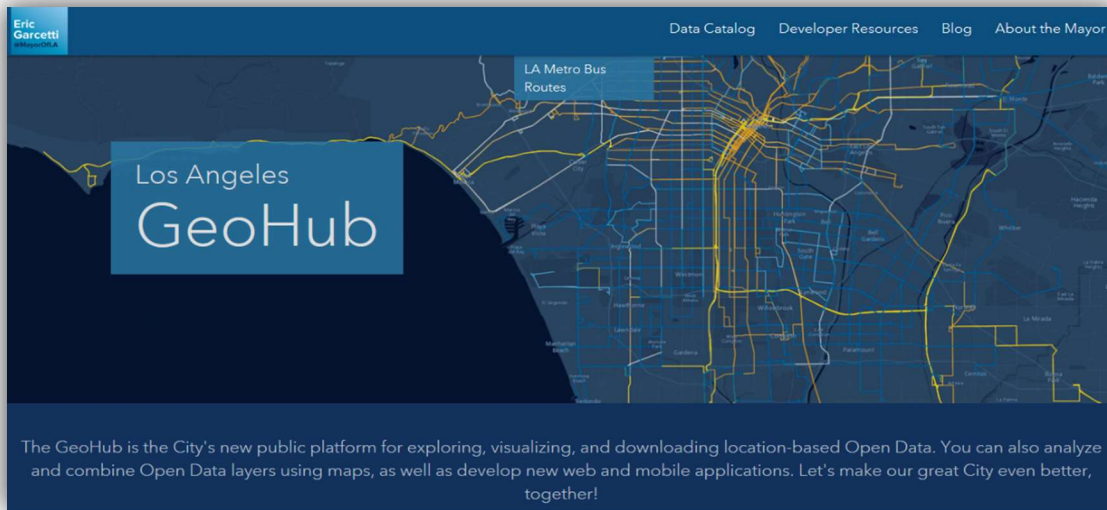
Mayor Eric Garcetti said: "GeoHub will help us reinvent the way that we deliver services and broaden our ability to engage residents and businesses to improve the quality of life in their city." (Esri, 2018)

The California Governor's Office of Emergency Services

GIS Data Hub is used for discovering public data layers and mapping applications to help with decision making during daily operations and incident operations.

The City of Brampton, Ontario, Canada

Public Hub is available to the public for exploring and downloading Open Data, learning about Brampton's Stories and analyzing and combining Open datasets to tell your own story.



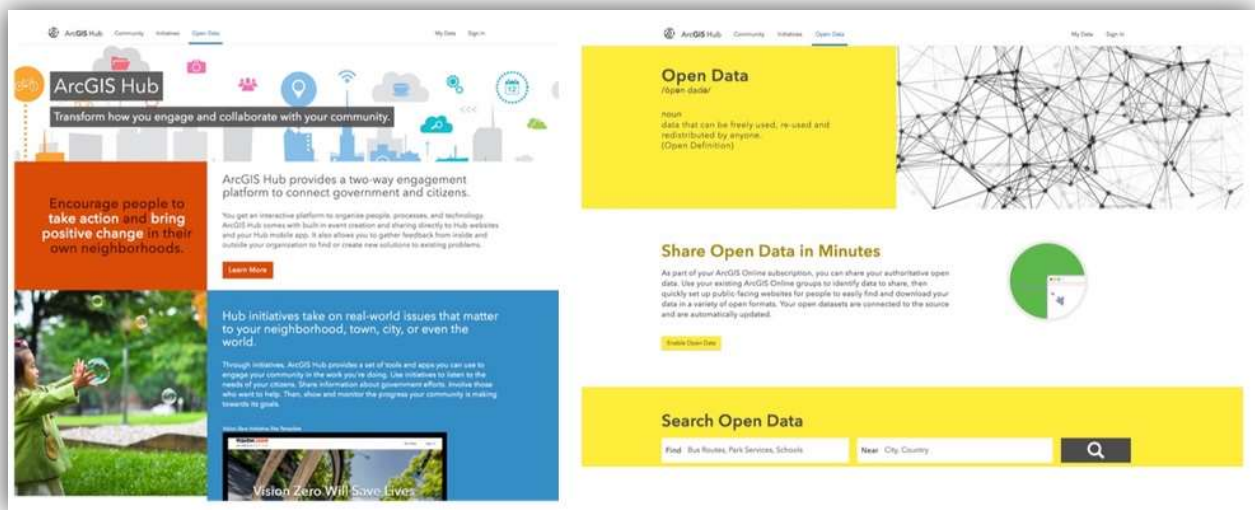
Los Angeles GeoHub

With a Hub, Irvine can leverage the power of location intelligence to strengthen the six core objectives of a smart, resilient and sustainable community:

- Safe
- Effective and efficient
- Livable
- Healthy
- Prosperous
- Sustainable

Data can be provided in a variety of formats such as spreadsheets, KML files, shapefiles, file geodatabases, and more. Users can download entire datasets or use a map to easily clip the data to their area of interest. Additionally, users can preview the data table to identify the attributes and information provided with the dataset.

This data should be connected to the City's enterprise geodatabase, ensuring the latest and greatest data is available for download by all users. To take it a step further, the City could leverage ArcGIS Sites, released at version 10.6.1, to provide targeted datasets to end users based on City departments. ArcGIS Hub is included with an ArcGIS Online subscription, but there are additional functions available for a fee. More information about ArcGIS Hub and ArcGIS Sites will be included in the software chapter of this document.



ArcGIS Hub / Open Data Portal Example

Public-Facing GIS and Story Maps (Enterprise)

Public-facing GIS tools would allow the public to learn more about the City's opportunities, operations, and stewardship endeavors. The GIS team has deployed a number of GIS applications for the community. However, it is recommended that a very targeted and concerted effort be established for public facing applications. The City's public information team members should be included as well as other key staff on a Geospatial Public Engagement team. Many cities make the mistake of allowing the GIS team to release a plethora of public-facing geospatial applications without an overall game plan. This is a mistake. Irvine needs a very thoughtful and deliberate plan for public-facing GIS applications. The City should do the following:

- **Form a Geospatial Customer Engagement team**
- **Review all existing public-facing GIS applications for pertinence**
- **Consider all of the public-facing applications listed in this document**
- **Formulate a strategy and game plan for the City of Irvine geospatial portals**
- **Consider how best to leverage ArcGIS Hub (previous need)**
- **Ensure consistency of applications**
- **Systematically launch applications based on a prioritization of needs and achievability**
- **Engage external experts to ensure optimal use of the technology and a professional look and feel**

There are multiple opportunities that will allow the City to share useful information with the public and external stakeholders. Deploying these applications will continue to develop the relationship between the City and the residents, businesses, and visitors it serves.

The GIS industry has made huge strides in software applications. Esri has released Story Maps technology which is designed to allow users to find information in a very intuitive and user-friendly fashion. Story Maps are targeted and are designed to be easy-to-use. The goal with Story Maps is to present key data sets to the public or internally without the need for training and to be able to get to pertinent data within a few clicks. As its name would indicate, Story Maps allow an organization to tell their story. With the use of Story Maps, the City has the opportunity to create public-facing resources to improve communications

with the public and external stakeholders pertaining to a wide variety of subject matter including, but not limited to, the following:

Community Development

- Home Ownership Associations (HOAs)
- The Current General Plan for Irvine

Great Park

- Virtual tour of Great Park to include:
 - Navigation
 - Way finding
 - All facilities
 - Reservable facilities
 - Schedules
 - 3D view of buildings and stadium

Public Works

- Irvine Green
 - Food waste prevention
 - Recycling facilities
 - Solar feasibility
 - Green cover

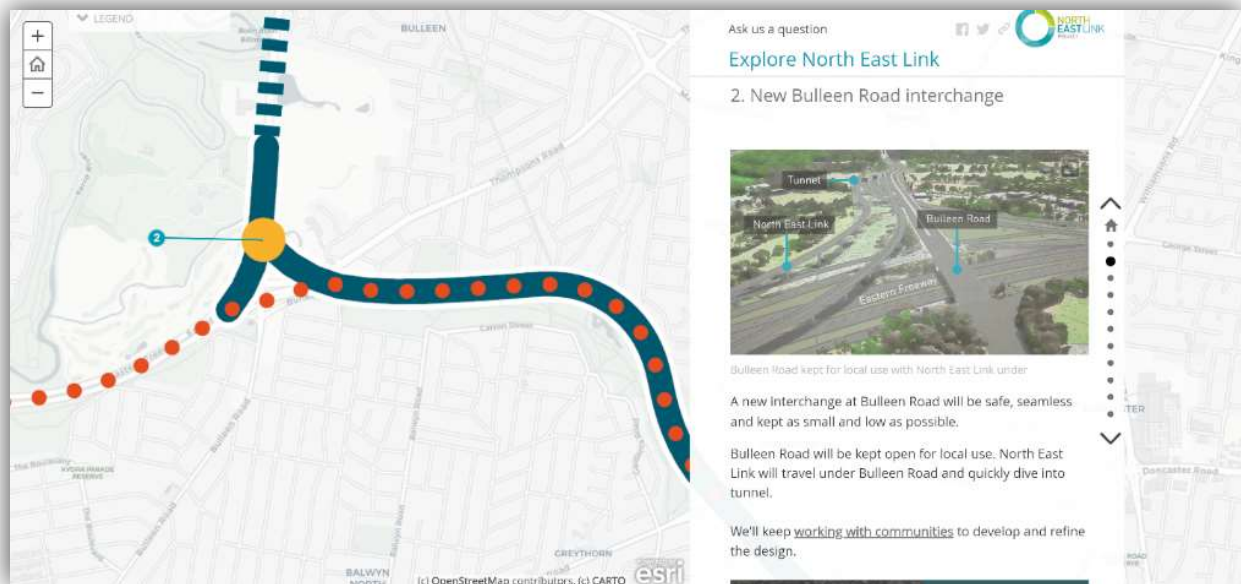
Transportation

- Key plans
 - ETA, SCAG, OCA, Regional Bike Plans

Public Safety

- Internal Story Map for Crime Briefings
- Meet the Officer Story Map
- National Night Out Story Map

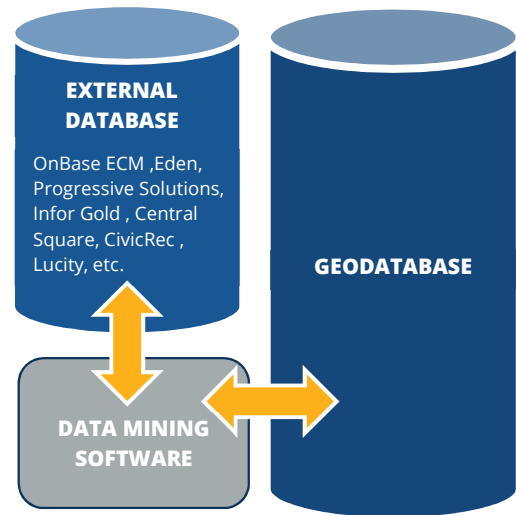
Some of these applications are mentioned again in the following needs as they are given more detail and/or are part of a targeted suite of applications.



Road Closure Story Map

Automated Data Mining and Integration (Enterprise)

The integration of non-spatial data with the Enterprise GIS is a need expressed by several departments across the City. Data mining can be used to extract data from existing databases by geo-coding addresses or mapping coordinates and placing the results into a relational database (Oracle or SQL). The extracted data can then be stored and managed within the database. The resulting tables can be made available for IT professionals and analyzed using application software. The analyzed data can then be presented in a useful format such as a graph or table. An on-premise deployed intranet mapping application should then be used as a front end for visualization of the data. The graphic above demonstrates in a generic sense the process of using data mining middleware to extract data.



Data Mining Process

Several companies have developed application software such as FME by Safe Software that is capable of overcoming format and data model barriers to moving data into various formats so that the corporation can leverage the data. In addition to FME, Esri offers a similar solution called ArcGIS Data Interoperability. Also, Esri business partners have created applications for this purpose (i.e. GeoMax from Geographic Technologies Group). Additional opportunities for the spatialization of data stored in existing applications/databases currently being used by the City are as follows:

- **OnBase ECM (documents and records management)**
- **Eden (code enforcement), Progressive Solutions (business licensing)**
- **Infor Gold (permitting)**
- **Central Square (finance)**
- **CivicRec (parks users)**
- **Lucity (asset management)**
- **Chameleon (animal control)**
- **Pavement management system**
- **Intergraph (CAD and RMS)**

Once the above information is maintained as digital data, it can be spatially enabled for use in the City GIS and used like any other GIS layer. Staff needs to make sure they have the data stored with necessary characteristics (XY coordinates or addresses) to geo-enable this data. Recording data with these characteristics will allow it to be integrated into existing records or geo-enabled. The integration of the enterprise GIS with other enterprise wide information systems will improve staff efficiency and increase communication, coordination, and collaboration across the organization.

Address Data Management (Enterprise)

Up-to-date, accurate address points are needed by all Irvine departments. Most departments interviewed expressed concern with the temporal accuracy (timeliness) and completeness of the address point layer. Public Safety needs address data before an address becomes final. This will necessitate changing the current process. The addressing process and data model need to be revisited. A pending address layer could be used to augment the approved address layer. Additionally, all multi-tenant dwellings need an address point on top of the unit. Today, many 911 calls are being located via the street centerline layer, which is not in the true spatial location of the call. In some cases, this delays the discovery of the actual location of the call. This has safety ramifications and can be corrected with a better address point layer. This layer and topic will be discussed further in more detail in the Data Analysis document of this project.



Esri's Address Data Management

Regarding maintenance of address points, the GIS section should consider implementing the ArcGIS Solution from Esri called Manage Address Information. It is a collection of maps and databases used to manage the core layers of road centerlines, site addresses, facilities, and mailing addresses, and also aggregates this information from authoritative sources for use by state and regional agencies. (See [https://solutions.arcgis.com/local-government/land-records/manage-addresses/.](https://solutions.arcgis.com/local-government/land-records/manage-addresses/))

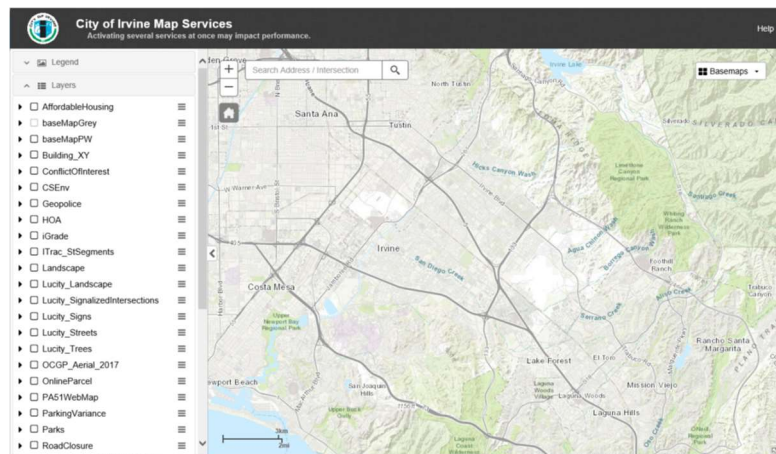
Intranet GIS Web Portal and Widgets (Enterprise)

The City has deployed a variety of applications internally and externally for users. An intranet GIS web browser (e.g. Esri Web AppBuilder) could be configured to provide staff in each work group with the tools and data they need to be able to complete their daily work. The City currently has deployed a number of ArcGIS Online portals (see graphic below). However, many organizations are implementing a common data browser with a robust set of tools and queries.

Many of the desired solutions expressed during the departmental interviews can be accomplished through a robust intranet browser using tools that are readily available in a web-based browser.

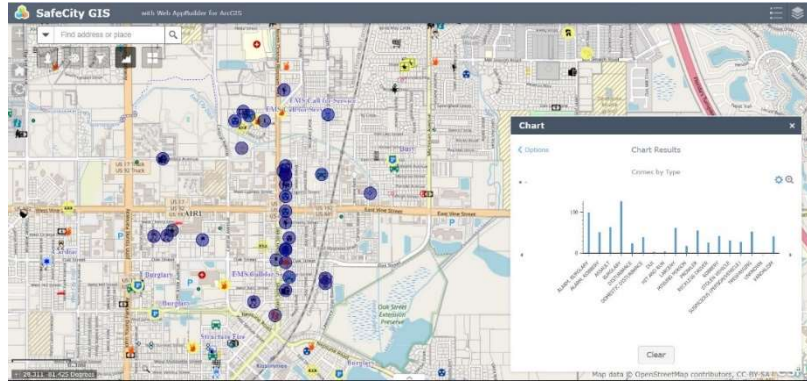
For instance, staff requested a flexible application that could be expanded through the development of widgets and

integration of third-party technologies like CivicRec, Lucity, and Eden. An intranet GIS web browser, deployed using a tool such as Esri Web AppBuilder (already owned by Irvine), could be configured for each individual department, providing staff with the tools and data they need to be able to complete their daily work. Front counter staff fielding basic inquiries from the public will be able to quickly navigate and identify needed information, as opposed to having limited functions from existing applications. In this model, every department uses the same tool but it is configured specifically for each department.



Existing ArcGIS Online Portal Example

An intranet web portal would be fully functional in the field, and staff would be able to use tablets or smartphones to access GIS information while completing field tasks. Irvine should consider creating personalized portals for key departments or groups of departments



Web AppBuilder Configured for Police

instead of a one-size-fits-all solution or multiple very narrow scope applications. The implementation of the portals will improve staff efficiency and productivity which will result in time and financial savings.

Metadata and Master Data List (Enterprise)

An enterprise need for Irvine is a viable and effective way to communicate and educate the organization about the data resources that exist. A number of departments at Irvine identified that they had no visibility into what data was available and into the data used/maintained by other departments. Furthermore, there is confusion amongst users as to whether a layer exists or not. Almost all GIS implementations struggle with an effective data awareness dissemination method.

A GIS Master Data List is, as the name implies, a listing of up-to-date information pertaining to all of the geographic and related datasets that are available for reference or utilization within the overall Enterprise GIS ecosystem. Master Data Lists are usually extracted from a larger body of information referred to as GIS metadata. In the simplest of terms, metadata is information about data. Similar to a library catalog record, metadata records document who, what, when, where, how, and why of an Enterprise GIS data resource. Among other things, metadata provides descriptive information maps, geographic data, imagery, and other location-based data resources. Geographic metadata can provide answers to questions such as:

- Who developed the data?
- When was the data collected?

- How was the data processed into its current state?
- How are the data attributes defined?
- In what formats are the data available?
- How does one obtain the data?

The information in the metadata provides context for the data and supports the effective application of the data. Metadata is an important resource for system users that need guidance on the fitness or suitability of a particular dataset to support analysis or render decisions based on the contents of a dataset.

The core components of a metadata record as recommended by the United States Federal Geographic Data Committee (FDGC) are as follows:

- **Metadata Record Information**
 - Information about the metadata record including the language in which the record is written, a unique file identifier for the metadata record, the metadata standard used to organize the record, a point of contact for the metadata record, and the date that the metadata record is written.
- **Identification Information**
 - Citation-level information about the data including the title, abstract, purpose for creation, status, keywords (theme and place), and extent (temporal, vertical and horizontal).
- **Constraints Information**
 - Information about legal and security limitations to data access and use.
- **Data Quality Information**
 - Information about the processes and sources used to develop the data and any positional and/or accuracy assessments performed.
- **Maintenance Information**

- Information about the scope, frequency, and methodology of data updates.
- **Spatial Representation**
 - Information about the mechanism used to represent spatial data (grid, point, and vector).
- **Reference System Information**
 - Information about the reference systems used to represent geographic position and time.
- **Content Information**
 - Information about the data set entities and attributes.
- **Symbology Information**
 - Information about the symbols used to represent spatial features.
- **Distribution Information**
 - Information about the data distributors and methods for obtaining the data.
- **Metadata Extension Information**
 - Information about custom, user-based, changes to the elements, domains or conditionality of the standard.
- **Schema Information**
 - Information about the schema or data models used to structure the data.

A mistake many organizations make is the belief that metadata is their Master Data List (MDL). This is erroneous. Metadata provides a wealth of detailed information that is necessary to understand the detail about a particular layer. However, most users just need to know if a layer exists and some basic information about that layer. Metadata is too cumbersome for a casual user. Additionally, often an MDL is created by technical staff who do not have a sense for creating something consumer ready. Including a person on an MDL team that has a sense of marketing techniques is important.

The MDL should be graphically pleasing and presented in such a way that a complete novice can understand what is being presented. A typical MDL might contain the following information:

- **Entity Name**
 - i.e. Roads
- **Entity Description**
 - I.e. comprehensive road layer of all roads in Irvine maintained by the Public Works Department. Contains accurate address information and pavement conditions.
- **Entity Type**
 - Point, line, polygon or composite – i.e. line
- **Entity Status**
 - i.e. maintained daily and fully complete

Users need access to a digital version of an MDL and a hard copy if needed. The MDL needs to be grouped in such a way that a novice user can quickly find data they are seeking.

Example groupings could be:

- **Economic Development**
- **Environment & Resource Protection**
- **Land Use**
- **Neighborhoods and Housing**
- **Parks, Public Spaces and Facilities**
- **Transportation**

On the digital version, a link could be embedded that would take the user to the location of the data layer. The MDL should have check boxes beside each layer so that the MDL can be used by users to select the data they want to consume in their various applications. An example MDL is provided below.

Example MDL

Roads & Streets		
DATA SET	UPDATE FREQUENCY	LINK TO DATA
Road Data Layer 1	Monthly	<input type="checkbox"/> RDL1
Road Data Layer 2	Daily	<input type="checkbox"/> RDL2
Road Data Layer 3	Quarterly	<input type="checkbox"/> RDL3
Road Data Layer 4	N/A	<input type="checkbox"/> RDL4
Road Data Layer 5	As Needed	<input type="checkbox"/> RDL5

Drainage & Sewers		
DATA SET	UPDATE FREQUENCY	LINK TO DATA
Drainage Data Layer 1	Daily	<input type="checkbox"/> DDL1
Drainage Data Layer 2	Weekly	<input type="checkbox"/> DDL2
Drainage Data Layer 3	Weekly	<input type="checkbox"/> DDL3
Drainage Data Layer 4	Annually	<input type="checkbox"/> DDL4
Drainage Data Layer 5	N/A	<input type="checkbox"/> DDL5

Buildings & Structures		
DATA SET	UPDATE FREQUENCY	LINK TO DATA
Structure Data Layer 1	N/A	<input type="checkbox"/> SDL1
Structure Data Layer 2	Quarterly	<input type="checkbox"/> SDL2
Structure Data Layer 3	As Needed	<input type="checkbox"/> SDL3
Structure Data Layer 4	Weekly	<input type="checkbox"/> SDL4
Structure Data Layer 5	Annually	<input type="checkbox"/> SDL5

A variety of approaches can be chosen to deliver the MDL to user desktops. Utilizing a web browser to provide this information is a popular approach which can employ a SQL RDBMS as the backend for record storage and retrieval, ASP.Net for the web tier and finally HTML5 as the front end and user interface. Hyperlinks can be embedded in the tabular data which can be selected to retrieve additional information pertaining to the MDL items. A comprehensive MDL will improve the utilization of the Enterprise GIS by ensuring that system users are aware of all available resources and understand the uses and limitations inherent in the data contained within the Enterprise GIS.

Additionally, an ongoing data awareness education game plan should be established and implemented. This should include:

- Once a year metadata/MDL workshops
- Online MDL brief training video
- Annual customer feedback survey on the effectiveness of the MDL

Operations Dashboard (Enterprise)

Esri's Operations Dashboard for ArcGIS is a configurable web app that provides location-aware data visualization and analytics for a real-time operational view of people, services, assets, and events. Operations Dashboards are being deployed as a targeted complement to data viewed in the intranet viewer (see the previous need). Each department can benefit from visualizing their key metrics and data in a dynamic dashboard. Esri's Operations Dashboard makes sense when looking at key metrics that have a geographic component. For example, Police staff would like to use a dashboard to see metrics about incidents. Public Works can benefit by viewing key metrics about infrastructure and projects (see example below).

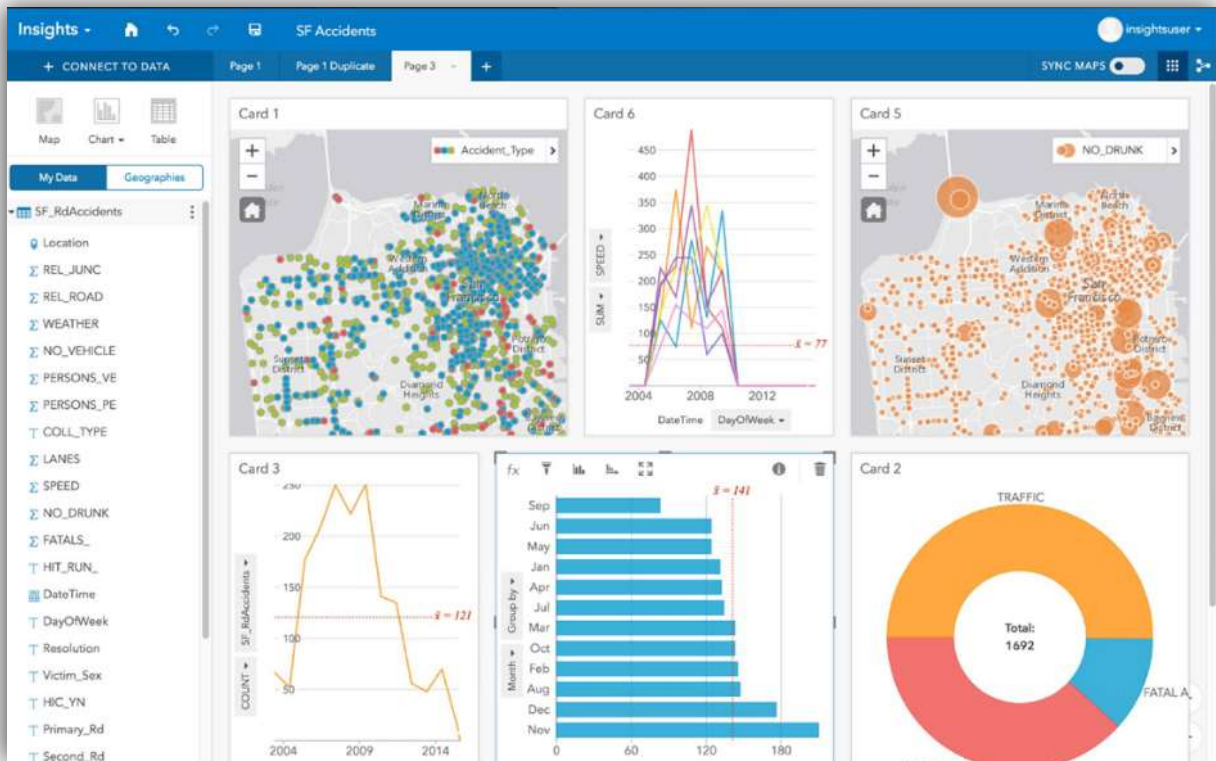


Operation Dashboard – Sidewalk Metrics (Vancouver, WA)

Staff at Irvine would benefit from having access to a real-time view of a variety of metrics specific to the business processes of their department. Dashboards can be configured to consume data from spatial data sets (GIS) and non-spatial datasets. Pertinent information is then displayed in real-time; for example, a department could be showing work orders as a bar chart by crew assigned and the location of the work order shown on the map. Dashboards can be configured to show live data updates, so as work orders are closed, the map and chart would reflect this change. Each department has its own set of metrics they would need to track.

For users that need a deeper analytical dive into their data, Esri has taken their dashboard toolset further with their new Insights for ArcGIS products. Insights allow users to explore data and perform advanced analytics such as spatial, statistical, predictive, and link analysis. Insights allow for direct data connections, yielding maps, charts, and tables allowing users to perform basic to complex analyses that scale based on skill level and business need. The Insights for ArcGIS interface can host all data—from enterprise data warehouses, ArcGIS data, geodatabases, spreadsheets, and big data. It would be beneficial for Irvine to train key analysts in various departments on how to use Insights.

Insights Enables Users to View Data in New Ways



Utilization of Portal Technology (Enterprise)

The City has begun using ArcGIS Online and associated applications. Esri provides access to the ArcGIS Online solution through an on-premise deployment called Portal for ArcGIS. Upon its initial release, Portal was reviewed by Irvine staff and they found it to not be robust enough for Irvine's needs. Staff opted instead to release native ArcGIS Online portals. However, Portal has matured over the past few years and needs to be considered by Irvine. Portal for ArcGIS allows organizations to have more control over web maps and hosted feature services while avoiding the need to consume credits for daily operations. Further contextual information about Portal for ArcGIS follows.

Starting with Esri version 10.5, the naming convention for ArcGIS for Server is now ArcGIS Enterprise, which includes Server and Portal for ArcGIS. Portal for ArcGIS is a server-based application that essentially provides ArcGIS Online functionality within an organization's intranet. Portal allows users to share maps, applications, and other geographic data with people in your organization. Portal provides the following major capabilities:

- **Website Configuration**
 - Control the “look and feel” of Irvine’ website, establish which services, base maps, templates, galleries, and groups are available to the end users
- **Access Control**
 - Manage the accounts that will access Portal through privileges, implement SSL if needed
- **Leverage ArcGIS Server**
 - Allow users to use map services in maps created with Portal

- **Deploy ArcGIS Data Store**
 - **Store feature data published in Portal in the ArcGIS Data Store; data replication is possible to build redundancy to support fault tolerance**
- **Create and Share Content**
 - **Build interactive maps and applications to share with others in the organization**
- **View and Edit Content**
 - **Use the Portal map viewer to edit maps and features**

The main reason Irvine should specifically utilize Portal for ArcGIS will be to ensure all data remains behind the City firewalls and are not hosted in the cloud. Additionally, the use of Portal will allow the City to further expand its mobile and online presence.

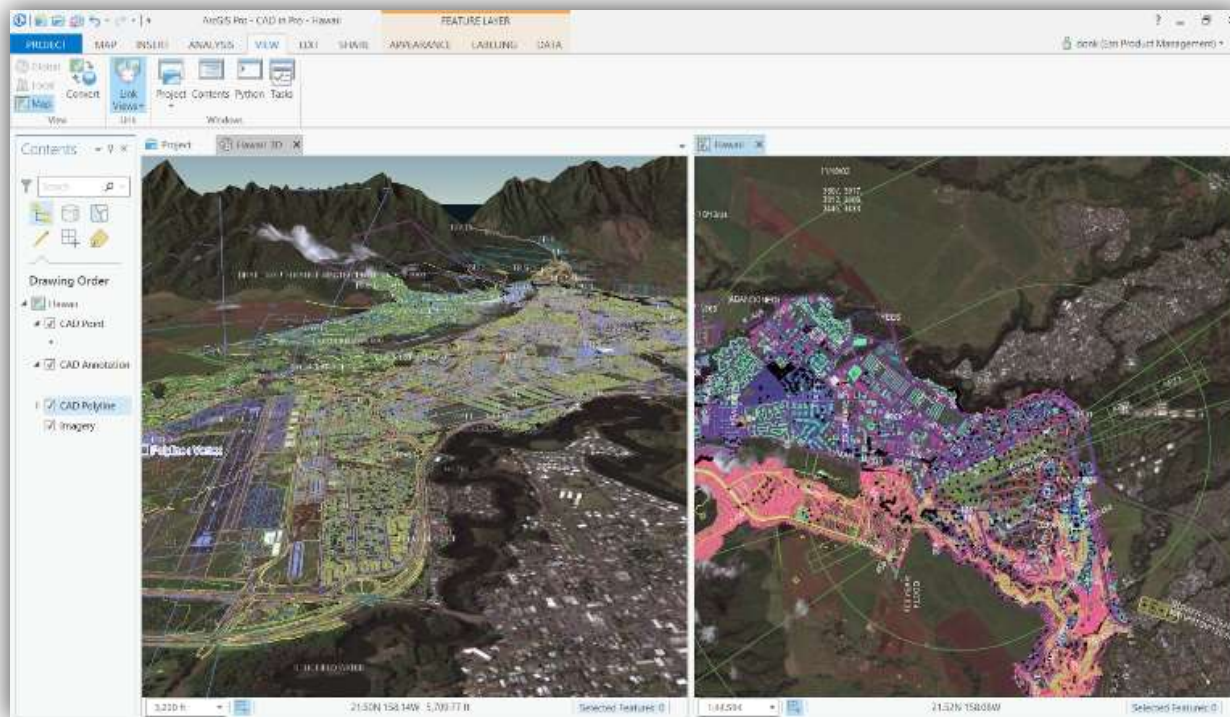
Migration to ArcGIS Pro (Enterprise)

It is recommended that the City begin planning the migration from ArcMap to ArcGIS Pro. Esri has indicated that ArcGIS Pro will be the eventual platform for core users and will replace ArcGIS Desktop. No definitive timeline for the depreciation of ArcGIS Desktop has been released.

ArcGIS Pro provides better efficiencies via the new “contextual” ribbon interface. The ribbon is designed to change and show the tools that are relevant to the tasks that the user is performing at any given time. ArcGIS Pro also takes advantage of 64-bit processing and multi-threading, which allows users to run parallel processes while continuing to use the application for other tasks. This increases performance and allows for improved efficiency.

Additionally, ArcGIS Pro features 2D/3D rendering, multiple layouts, the addition of charts/graphs, ease of consuming and sharing web data. It integrates with ArcGIS Online, Enterprise, and Portal enabling users to easily create, share, and collaborate with everyone.

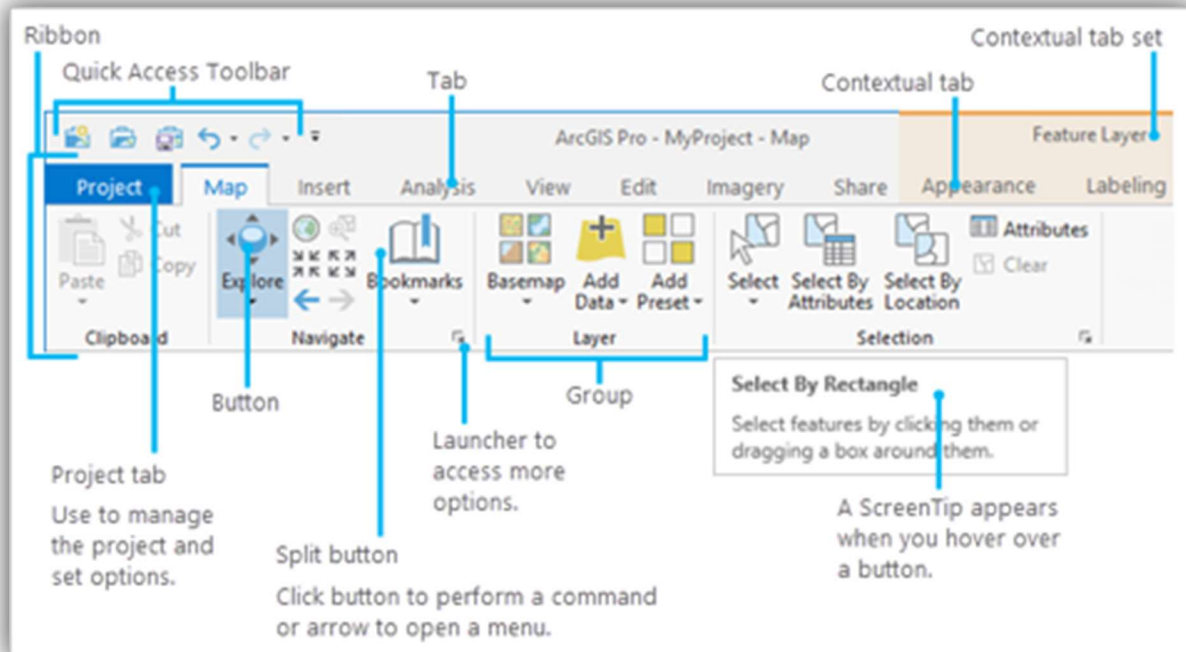
Example ArcGIS Pro



While the benefits are numerous, there are several factors that need to be carefully considered prior to migration. Being a relatively new application, several key functionalities that users rely on for day-to-day operation are not yet available. Other tools, if implemented, are not backward compatible, meaning, once migration occurs, regular ArcMap desktop users will not be able to consume the data via ArcMap.

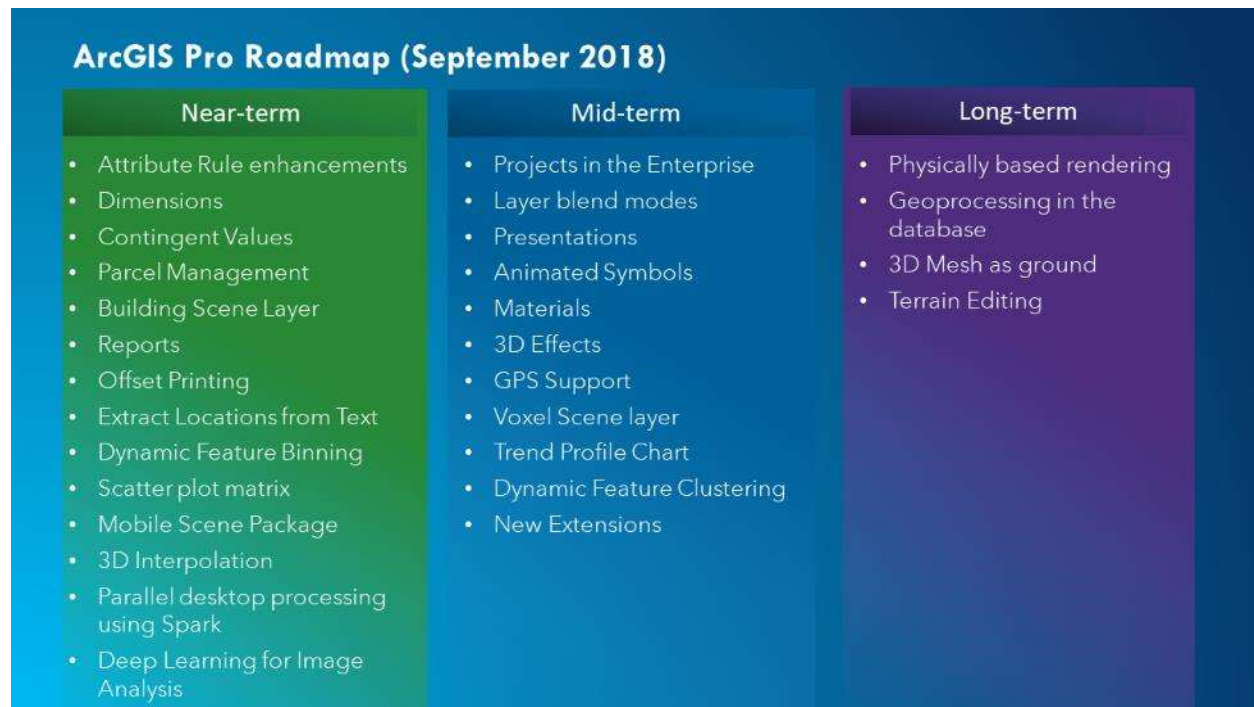
As an example, the old data model for utilities has been completely rebuilt and is no longer a part of the local government information model (LGIM). It is now an independent data model called "Utility Network." The Utility Network only works with ArcGIS Pro and is not compatible with ArcMap. Similarly, ArcGIS Pro users will not be able to modify geometric network features. Utility Network needs to be configured prior to full migration if the network is to be utilized.

ArcGIS Pro Ribbon



Another example of new tools is the “Attribute Assistant” that helps auto-populate fields upon feature creation. This tool has been redesigned and is now called “Attribute Rules.” This tool is new in ArcGIS Pro 2.2 and requires an initial configuration. Once set up and deployed, the data can no longer be consumed in ArcMap.

The City should implement a phased transition to ArcGIS Pro, starting with users who would be least affected (those who consume existing information for only analysis or map making). For users responsible for adding and maintaining data (mainly the GIS team in IT), we recommend that they identify and document all workflows, especially those requiring custom, third-party, or specialty tools such as geometric networks, topology, attribute assistant, and parcel-fabric. The optimum plan would be to use matrix style documentation to record current and required functionalities and try to sync the transition with the release of complementary ArcGIS Pro functionalities. Esri has published an ArcGIS Roadmap (below).



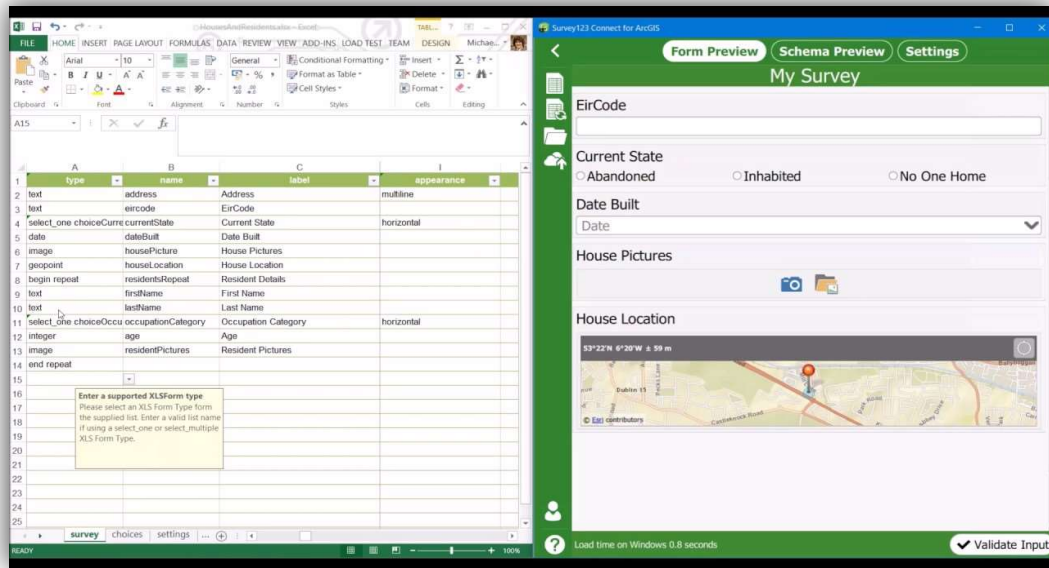
Mobile Data Collection and Viewing

The City should consider further expanding the editing and viewing GIS information in the field. Instead of taking paper maps into the field to mark data irregularities, an application such as the Field Markup Tool through the Collector App, would allow staff the ability to collect new GIS information, or to record and correct discrepancies in existing GIS data as well as capture photos of assets and attach them to the corresponding entities in the Enterprise GIS. This allows the organization from the field to back office to focus on data cleanup and validation in a more efficient manner.

Collector works on Windows, iOS, or Android devices and is used to collect and update information in the field, with or without an internet connection. Once data is collected, it is automatically sent to the corporate enterprise database. Specific applications for mobile GIS at the City include the provision of field staff with tools to collect park infrastructure information, or the ability to capture information about any assets under management. Survey123 from Esri could be deployed to capture such data in the field. The implementation of mobile GIS collection and viewing capabilities will improve asset management procedures at the City, resulting in a saving of time, resources, and funds.

Additionally, for viewing data, the recommended Web AppBuilder application is a great tool for field data viewing and queries.

Survey123 is user configurable for custom designed field survey use.



3D Visualization and ArcGIS Urban (Enterprise)

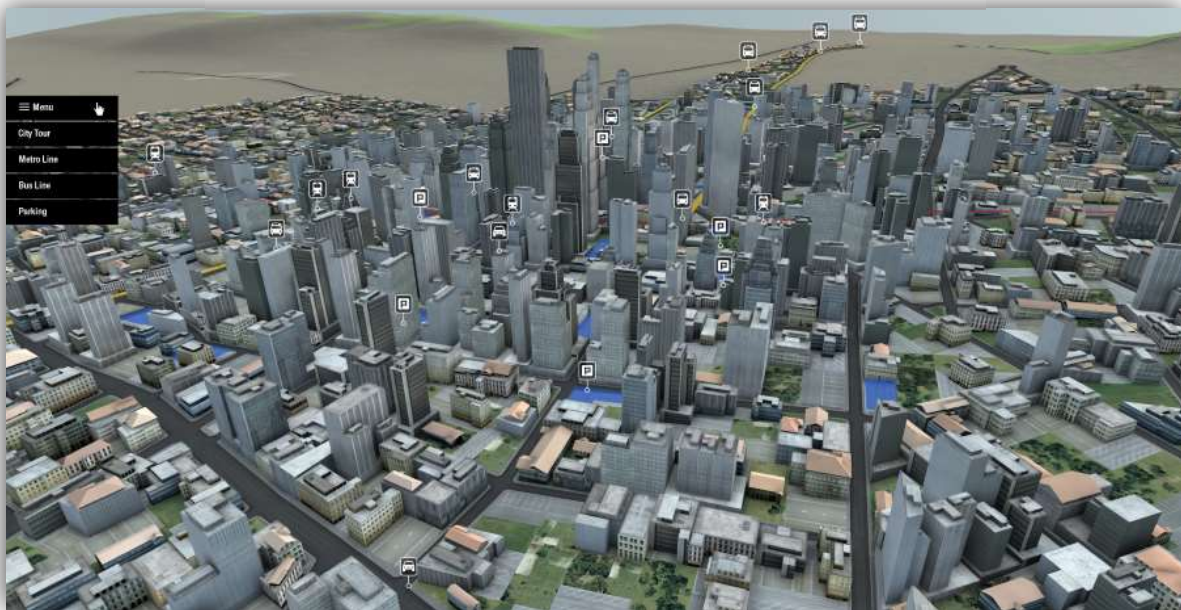
Staff has requested functionality that will permit the visualization of various data sets in 3D. This includes topography, buildings, and park features (Great Park Stadium). To facilitate this need, the City should consider the implementation of Esri CityEngine. Irvine already has a wealth of 3D data, especially for Great Park.

Esri CityEngine is a three-dimensional (3D) software application developed for the generation of 3D urban environments. Using a procedural modeling approach, CityEngine supports the creation of detailed large-scale 3D city models. CityEngine works with architectural object placement and arrangement in the same manner that comparable software packages manage terrain, ecosystems, and atmosphere mapping. Unlike traditional 3D modeling methodology which uses computer-aided design tools, CityEngine improves the shape generation using a parametric rule-based system and constructs data sets in a fashion that is similar to GIS. CityEngine has been broadly used in academic research to construct virtual environments. CityEngine can visualize the data of buildings in a larger urban context as shown in the image below. CityEngine also supports the

visualization of building massing based on parcel specific building setbacks, floor area ratios, maximum heights, and other site-specific planning metrics.

Additionally, ArcGIS Urban has been released and should be considered a component of the 3D effort. ArcGIS Urban is a collection of web-based and desktop tools to help create and manage plans and projects, engage with community stakeholders, and reduce risk. ArcGIS Urban combines real-world information with zoning rules and will put this into the hands of users, supporting neighborhood planning activities in the context of active real estate development. Using ArcGIS Urban, professionals who plan and construct new projects in cities will better understand how regulations will shape their buildings. ArcGIS Urban will provide clear, color-coded 3D models of neighborhoods that can be navigated to see exactly what these requirements are, where they are enforced, and how they will inform current construction as well as future projects, resulting in a more economically prosperous, resilient, and vibrant city.

3D Modeling of Buildings



Drone imagery (Enterprise)

Drone2Map for ArcGIS streamlines the creation of professional imagery products from drone-captured imagery for visualization and analysis. With Drone2Map, Irvine can create base maps, perform image analysis, measure features, and develop topographic models of project sites with detailed digital surface models. 3D textured meshes can be created to support modeling, planning, and collaboration. The creation of 3D point clouds from the collected imagery can facilitate the analysis of natural and built-up features including volumetric measurements, change detection as well as a line of sight and related obstruction analysis.

City staff would need to undertake training in order to safely operate a drone and comply with applicable Federal Aviation Authority (FAA) guidelines and regulations governing the operation of a drone. Alternatively, the City can develop a partnership with an FAA-certified drone operator and focus on post-processing any collected imagery. The incorporation of drone-collected imagery into City workflows will improve the quantity and quality of information used to make decisions, thus leading to improved decision making by staff.

Drone used to collect site imagery.



Specific uses/needs noted during the interviews:

- **Public Safety**
 - Search and rescue, confined spaces where helicopter unavailable
 - Mapping traffic collisions
- **Transportation**
 - Signal modification plans for signal timing parameters, to measure any lanes
 - Bike and pedestrian counts for planning
- **EOC**
 - Vegetation Vulnerabilities
 - Post disaster assessment
- **Citywide**
 - Mapping specific project locations to get 3D data and new imagery

Training (Enterprise)

A need that is critical for all departments is targeted training. Several recommendations have been made for staff to adopt new technologies and applications. Department staff will need to be trained in how to utilize everything from the departmental intranet portal to mobile tools and hardware. Staff will only realize the full return on investment and increased efficiencies with full knowledge of all tools. Most of the training can be completed through web courses or instructor-led online courses through Esri's eLearning or other GIS Training vendors. Specific classes on ArcGIS Pro will need to be offered to

ArcGIS Desktop users. A chapter defining a training and education plan for the City is included later in this study.



GIS training in a classroom setting.

Geospatial Technology and Smart Urban Areas (Enterprise)

Although, not explicitly identified during interviews, City staff have shown an interest in leveraging innovative products. Many cities are beginning to use ‘smart city’ technology data from which is visualized via GIS. The term ‘smart city’ is becoming more popular as organizations invest in new technologies and policies designed to deliver services more efficiently. Smart devices are those that collect information remotely and report back automatically to the organization. Historically, SCADA devices were used for remote monitoring of infrastructure. Additionally, automatic vehicle location (AVL) devices were put on public safety and other public vehicles to track location and other key metrics. This self-reporting technology has expanded to include any device in the field that collects key information and metrics. One key component of any ‘smart initiative’ is geospatial technology. These smart devices are spatially aware and thus the resultant data should be

made available throughout the organization. Irvine can benefit from these types of self-reporting devices. Traffic volume and flow monitoring, park usage monitoring, and various public safety related devices could be considered by Irvine.

When smart technology is incorporated into an organization’s infrastructure, it generates a significant amount of valuable data that can be harnessed, analyzed, and acted upon. The AT&T Smart Cities Operations Center aggregates this data into a dashboard, providing leaders with a holistic, centralized view of ongoing activity. This offers leaders the information they need to better deploy resources, minimize crisis response times, improve service delivery, and act on issues that arise. The AT&T Smart Cities solution suite includes Digital Infrastructure, Structure Monitoring, and Smart Irrigation, tying them together with the Smart Cities Operation Center in a customized dashboard, consisting of panels for service areas of concern, such as traffic, parking, public safety, and the environment.

Smart Infrastructure Dashboard



Best of Breed Smart City Examples

City of Portland, Oregon, USA:

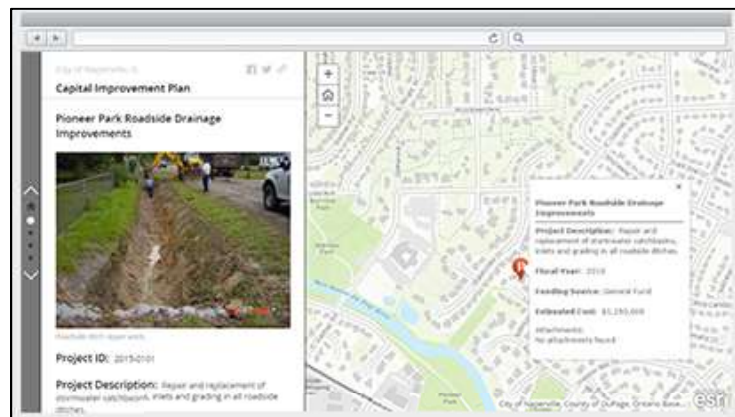
The City of Portland, Oregon, is planning to use smart city digital infrastructure to transform some existing lighting infrastructure into a sensor-enabled data network. The sensors help the City of Portland address issues like traffic flow and parking.

City of Las Vegas, Nevada, USA:

The City of Las Vegas, Nevada, uses video cameras and sound sensors to improve traffic management in an area of the city's Innovation District. "The future is now, and government must be ready to embrace technologies that can help to address community issues and make cities more livable," Las Vegas Mayor Carolyn Goodman said in a statement. (SmartCitiesDive, 2018)

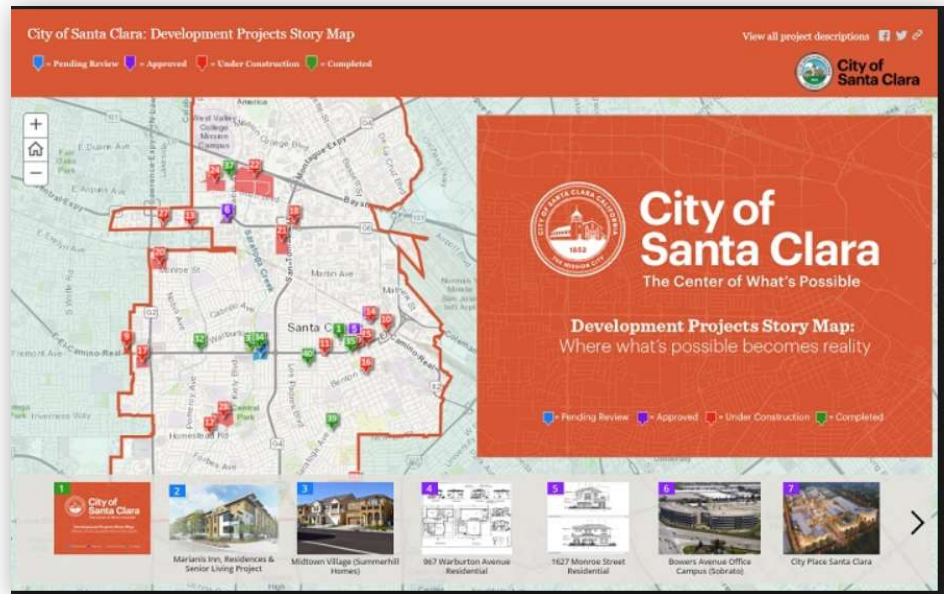
Capital Improvement Program (CIP) GIS (Enterprise)

The City manages several ongoing projects simultaneously. Various departments are involved in these projects. The City has created an internal CIP mapping application available via the intranet. This program should be expanded to be more pervasive and to include past, current, and future CIP projects. A comprehensive CIP layer should be maintained with links to key documents (OnBase) and to permitting information. Various tools should be considered as a part of this initiative. Esri has released an ArcGIS toolset for Capital Projects. Capital Project Planning is an ArcGIS configuration that can be used to coordinate capital projects, engage external agencies, and share capital improvement plans with the public. This application works in conjunction with the Capital Project Tracking application to provide a comprehensive capital projects solution including web maps and a public-facing Story Map.



Esri's Capital Project Planning Tool

The CIP layer and associated queries would be available to internal users through the recommended Web AppBuilder. Another effective way to share project information internally and with the public is through Esri Story Maps. This would allow the City to



Example Project Story Map

display the past, present, and upcoming projects. This should be done in collaboration with other departments to provide a way for the public to visualize these undertakings. The ability to display infrastructure renewal and upgrade information promotes open government and is an attractive way to relay information to residents about where taxpayer dollars are being spent.

OnBase/Esri Integration (City Clerk with Enterprise Impact)

The City document management system (OnBase) contains a wealth of documents and records that are available for integration with GIS. Spatializing this information through deeper integration of the OnBase with the City GIS will improve staff and citizen access to the information that is housed in that platform. In light of this, the City should move forward with the planned purchase of the OnBase Esri integration API and implement this extension to the OnBase ECM. This information could then be accessed by departments within the various recommended GIS applications.

Based on the OnBase website integration with Esri allows for:

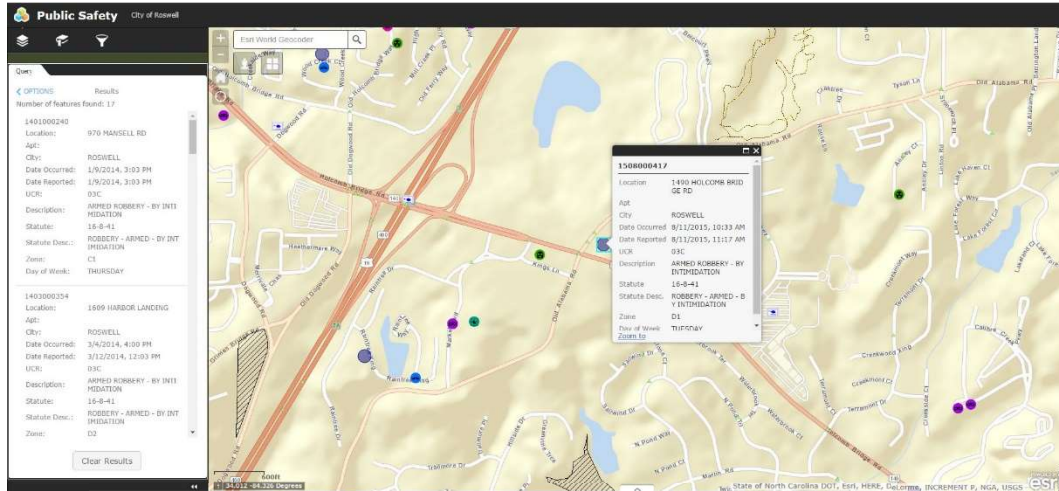
- **Geo-enabling documents in OnBase**
- **Save modified images in OnBase for use within the automated workflow process**
- **Run location analytics on existing content within OnBase**

Key concerns for Irvine are as follows:

- **Is the licensing enterprise-wide**
- **How are the images linked (parcel number, address, etc.)**
- **Making sure these links are incorporated into the OnBase work flow**
- **Historic documents – how far back to go to give geospatial links to documents**

Intranet Web Portal (Police)

Although discussed previously as an enterprise need, specific examples of the use of the Web AppBuilder are merited. The Irvine Police Department does have GIS crime analysts. Currently, the staff has to go to various portals to retrieve pertinent data. Today, officers rely on hard copy maps or inferior mapping products from Integraph or commercial applications (Google Maps). It is relatively easy to configure the Web AppBuilder for officers to get their own incident map focused on their area of concern. This could be made available internally or in the vehicles. This portal could be deployed using Esri's Web AppBuilder, allowing staff to conduct basic spatial analysis, produce maps, and assist in day-to-day activities and operations, all while remaining behind the City's firewalls. This will allow access on mobile devices, giving Officers access from their vehicles or mobile devices to real mapping and analytics capabilities.



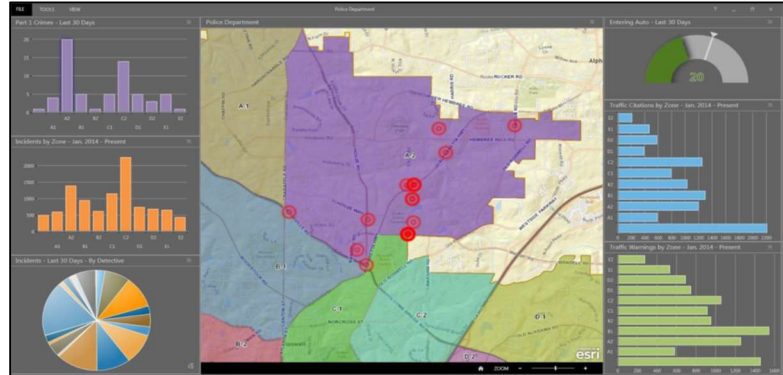
Web AppBuilder Configuration for Police

The Police Department should use an intranet portal for the following functions, mapping, and analysis:

- Mapping E-911 Calls from dispatch
- Crisis management – schools and other critical business with data in cruisers
- Mapping sex offenders, parolees, probationers, persons with warrants
- View and query existing infrastructure – water, sewer, stormwater, and facilities
- View and query utility billing information
- Weekly PIN map and Hot Spot Analysis
- Buffer tools
- Court case support for detectives
- Logistical support (i.e. planning for a raid)
- Tracking drug-free zones around schools
- View aerial imagery for drug raids and traffic accident analysis
- Track history of individuals via an aggregate database
- Visualize the location of speed zones, survey zones, etc.
- Situational and operational awareness
- Integration of CCTV feeds
- Location of key infrastructure

Executive Dashboard (Police)

A tool that would benefit the Irvine Police Department is the Esri Executive Dashboard application. Organizations use Operations Dashboard to monitor various key metrics. For example, departments are using dashboards to view incidents by a variety of variables such as type, incidents within the last 30 days, incidents by officer, incidents by beat, and traffic accidents among others. It is recommended that the Police Department in conjunction with the GIS staff develop an Executive Dashboard for command staff. This involves a process of deciding what should be viewed and then mining the data using the aforementioned backend data mining toolset. The result is a live look at key metrics via user selected widgets and an interactive map.



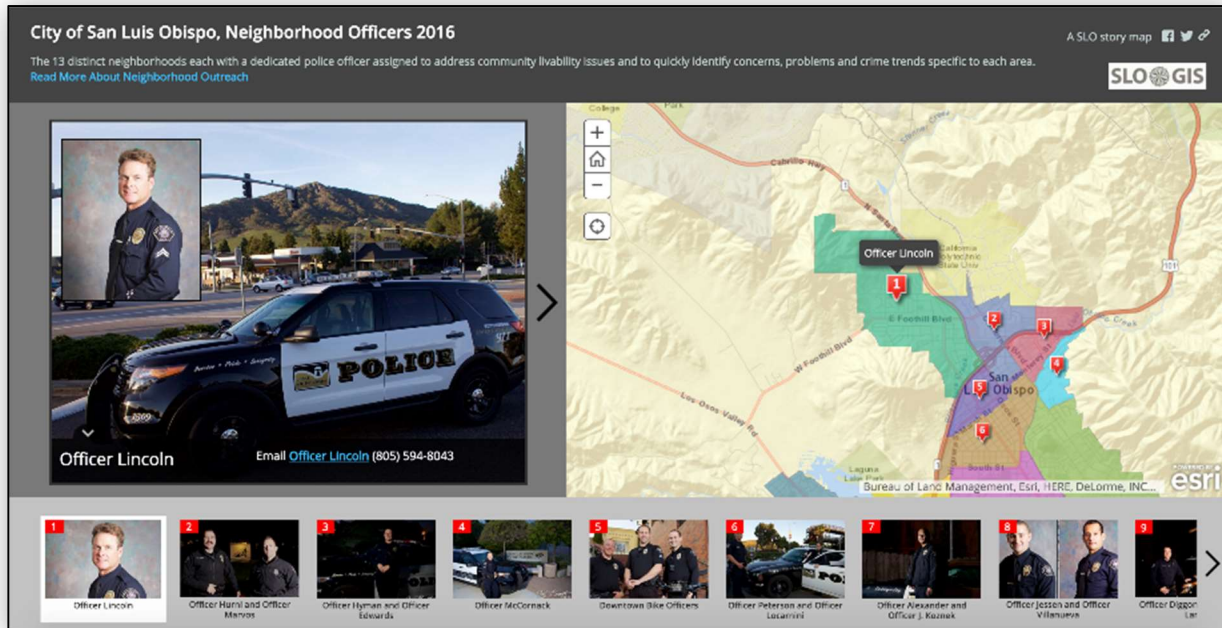
Executive Dashboard for Police Decision Makers

Story Maps (Police)

Story Maps provide an intuitive, easy-to-use platform to share data with the public about a variety of topics. For policing, Story Maps would be a tremendous tool to promote outreach programs and partnerships such as the National Night Out program. Public-facing applications of interest for the Police Department include:

- Internal Crime Briefings
- National Night Out
- Meet the Officer Story Maps
- Cold Case Story Map

Example of a story map showcasing police officers and their areas of patrol



Miscellaneous (Police)

The Police Department also requested a few additional items as follows:

- An additional copy of Spatial Analyst dedicated to their team
- Better tools for making map books

Emergency Operations Suite (EOC)

Emergency Operations' involved staff are required to participate and lead the City in disaster response and recovery, as well as being in the field after a disaster; such as after a flood, fire, or a terrorist event. They are required to participate in damage assessments and report this information back to the City for reporting to the state and Federal Government and for recovery operations. It is recommended that Irvine implement a disaster recovery tool that will enable staff with tablets to quickly assess and report the extent of a disaster. This application will allow users to enter the damage done on a site-by-site basis. Also, the

computers are GPS-enabled allowing for the location of each field representative and the path they have already traveled to be easily ascertained.

Emergency Services should leverage all of the functionality afforded through a modern GIS. The City has invested in Esri GIS technology, which has a number of tools that can be used to meet the mapping needs of the department. The tools are as follows.

EOC Common Operational Picture

One easy-to-use but powerful resource the City's Emergency Operations Center (EOC) could use in the event of an emergency is a common operational picture (COP). GIS provides a framework to integrate data from disparate sources—event data; critical infrastructure data such as hospitals, clinics, schools, and roads; pharmaceutical stockpile sites; political boundaries; and real-time data feeds, such as weather, traffic, and data from WebEOC.

COP then allows an agency to visualize, analyze, and map that information to create a common operational picture for communication and decision-making purposes. A COP, developed through a tool like Esri Web AppBuilder, would provide key GIS layers and analytics to all staff involved in disaster emergency response via a central browser.

This application would allow EOC staff to quickly visualize and assess a disaster in a live environment. Reports and queries would be set up within the software for mapping, analysis, and reporting. Additionally, this same browser can be used for analysis and mapping for non-emergency planning. The application allows for the following functionality:

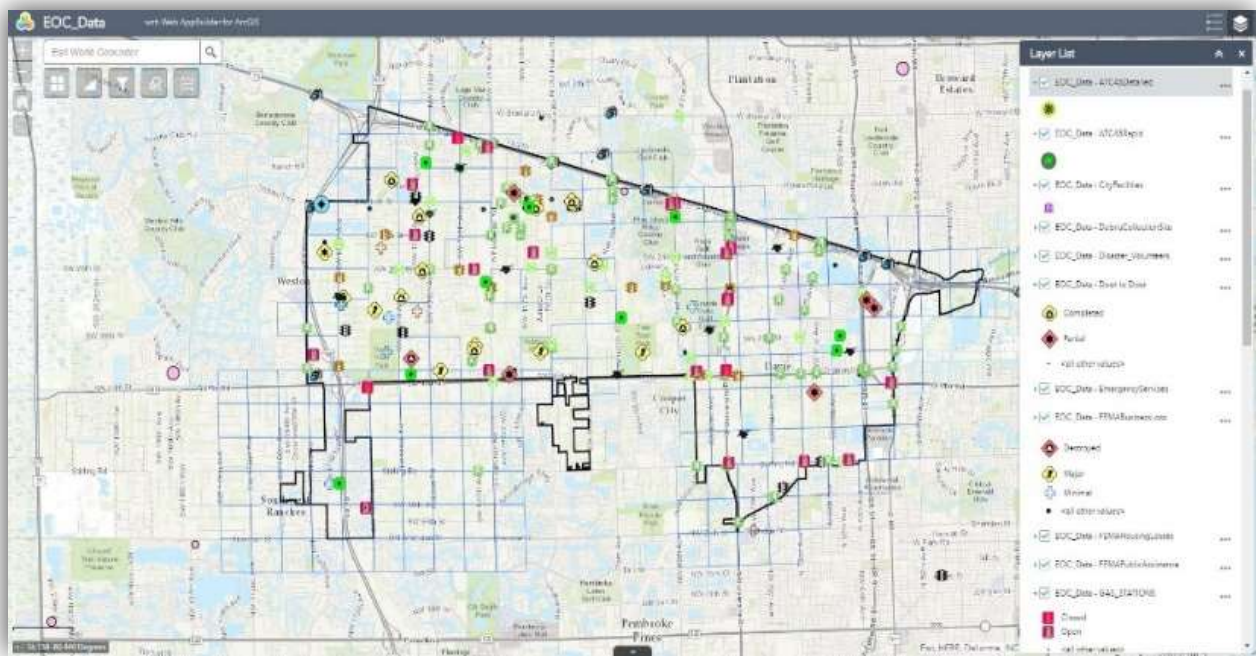
- **Flood impact analysis**
 - How many people may be affected?
 - What critical infrastructure may be affected?
 - What target properties (schools, nursing homes, etc.) may be affected?
- **Evacuation Planning**
 - The goal would be to design an effective evacuation plan for a given incident or to change an existing evacuation due to dynamic conditions.

- Determine street capacities to manage expected evacuation capacity – i.e. if the need to evacuate 15000 people in 2 hours and the streets in area flow x vehicles per hour, how many streets do we need to designate as evacuation routes
- Identify stop lights and other traffic control devices that will need to be controlled to assist with evacuation

All critical information would be able to be included such as:

- Shelter locations and information
- Live GPS feeds from the field showing damage assessment activities
- Key infrastructure
- Evacuation routes
- Traffic flow patterns
- Database of emergency response team members personal information

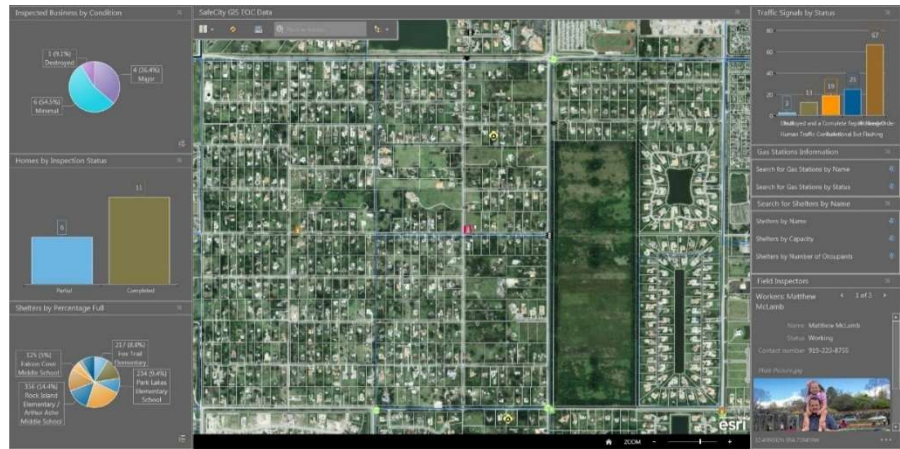
EOC Common Operational Picture



- Essential locations including critical businesses, hospitals, staging areas, traffic feeds, volunteer locations, etc.
- Hazardous sites
- Long-term care facility data to better understand the concentrations of senior citizens

EOC Dashboard

The City would benefit from developing an EOC dashboard. Esri has released its Executive Dashboard application that can be used for this purpose. The dashboard can be configured to view any key metrics. The toolset provides organizations with an application for monitoring real-time data related to an emergency situation. For example:

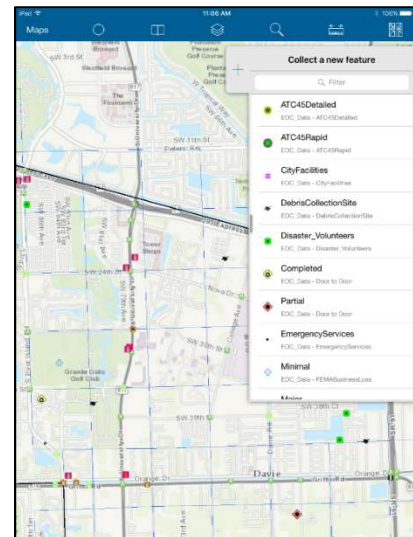


GIS EOC Dashboard

- Total area canvassed
- Damage by percentage
- Location of all field personnel

EOC Damage Assessment Tools

A mobile application rounds out the internal EOC suite. The Esri Collector Application (which the City currently owns) should allow users to rapidly and confidently enter field notes on a mobile form and then Esri Collector App Configured for



EOC Configured Collector
Application

Damage Assessment transmits the data back to a central location using a wireless connection. Routing and tracking staff during an emergency are also a benefit of using GPS-enabled tablets during an event. This application suite should be tested as part of the emergency preparedness process to ensure that each of the components is in an operational state.

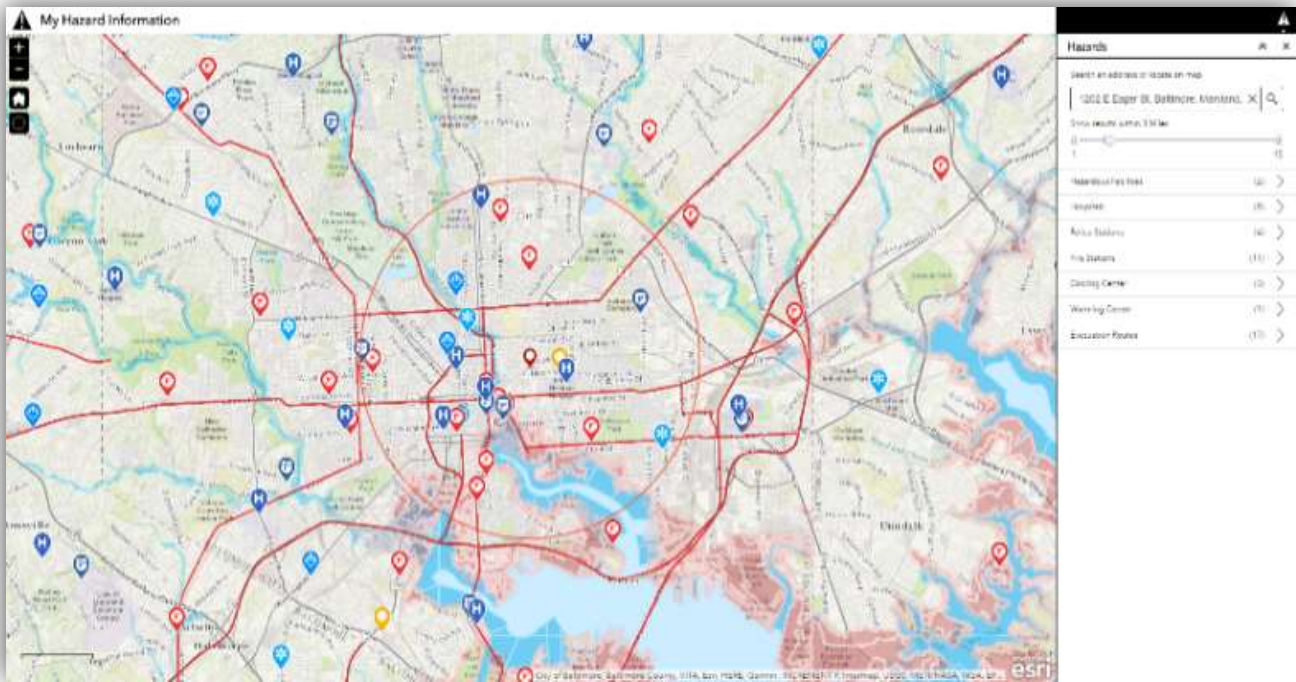
EOC Public Disaster Map

The City of Irvine should consider a public-facing Emergency Operations Map for disaster management. Some datasets that could be included are:

- Shelter locations and evacuation routes
- Incidence response management
- Critical facilities
- Road closures
- Power outages
- Any other pertinent data residents could use in preparation for a disaster.

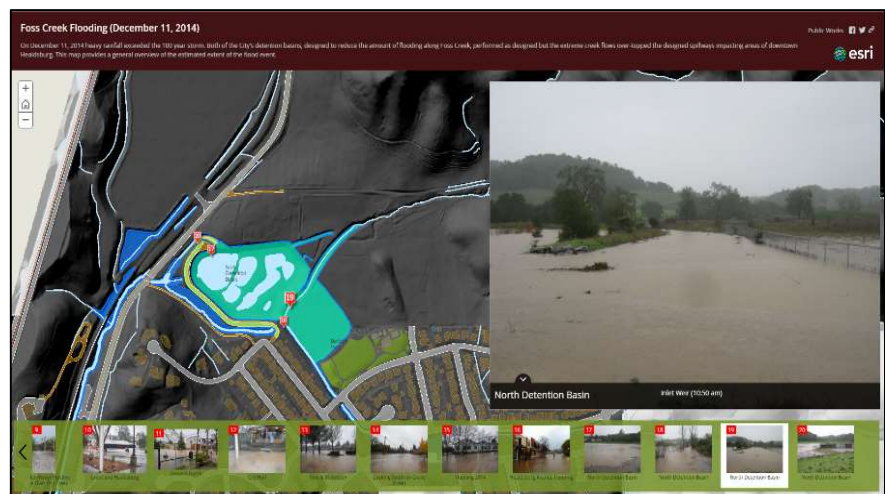
One tool that could be utilized for this is Esri's My Hazard Information Map application, a public-facing web browser that allows residents to type in their address and identify the nearest critical facilities in a specified radius.

My Hazard Information Application



The My Hazard Information application helps residents discover hazards that exist in their community and obtain information about evacuation routes and government facilities. Staff would be able to determine what information is displayed on the browser, with a variety of potential choices including hospitals, hazardous facilities, evacuation routes, and other pertinent information.

After an emergency such as a natural disaster, government entities often want to display the impact of the event and highlight response efforts. Story Maps would allow staff to share maps with the public that included text, images, and other forms of multimedia content in a way that is easy for the



Story Map Highlighting Flooding Event

public to consume, supporting Irvine' desire to educate and inform the public. Various Story Maps are recommended for EOC to include:

- Living document that shows key elements of the hazard mitigation plan
- Emergency Operations Story Map showing critical facilities and emergency game plan
- Post disaster story map

Parks Suite (Great Park and Community Services)

Asset Inventory

Parks in the City of Irvine contain an array of assets. While Public Works is responsible for maintaining park assets, Community Services and Great Park staff would benefit from utilizing GIS as a tool to view and track assets. It is essential that the parks assets inventory is continuously updated and checked for quality assurance purposes.

Parks related staff will benefit from GIS as long as the assets, facilities, and buildings can be represented and displayed within the GIS. A comprehensive field inventory should be conducted of all park assets.

Photos should be taken of each asset. Each of these photos should be linked geographically

to their GIS asset. During the field inspection process, each asset should be given a rating and a color code based on this rating. For instance, an asset given a bad rating will receive a color code of red in the database, those in moderate condition receive a yellow, and those in good condition receive a green color code. The GIS data layers should be created, and an updated application released to staff.

The following is a sample list of assets that could be represented in the GIS; the parentheses identify the data type each asset would be represented by:



Example of Park Assets Mapped

- Trees (points);
- Trails (segments, lines);
- Playing fields and amenities - fences, benches, light poles, bat racks, score boards (polygons, points, lines);
- Picnic areas (points, polygons);
- Shelters and buildings (polygons);
- Play structures (points, polygons, lines);
- Bleachers (point).

Any type of infrastructure can be tracked or monitored through GIS. Parks focused staff needs to work collaboratively with the GIS staff and the staff in Public Works to determine a comprehensive list of assets desired and an appropriate list of attributes. For example, for trails, the following data needs to be included: surface material, access points, type of trail, trail width, and mile markers. These details should be part of the database design process, which will ultimately form the base for the park asset inventory. This asset inventory should be collected in the field using mobile data editing tools.

Intranet Portal

In order to provide a targeted view of all Parks related data, Irvine needs to consider intranet portals that are specific to departments. Parks staff would have access to a portal configured to display park related data, reports, and queries pertinent to their needs. It will allow staff to view both inter and intra-departmental GIS data as well as information submitted into integrated system databases including CivicRec and Lucity. Key uses of the intranet application include:



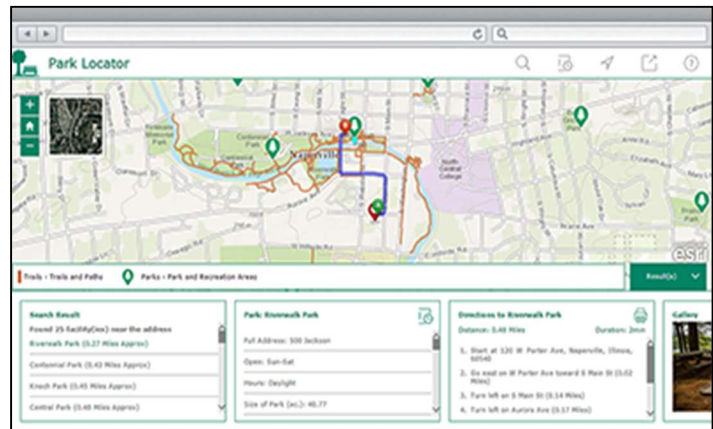
Intranet Portal configured for a Parks Department

- Viewing patron demographics (including parks, facilities, and users);
- Identify trails by type, surface, and access points;
- Querying Recreation and Park Assets;
- Identifying problem areas based on work orders completed;

- Quickly assisting patrons in answering spatially related questions;
- Integrating census and demographic data for a more thorough analysis of patrons and underserved populations;
- Creating heat maps to identify the high concentration of athletic program participants;
- Integrating disparate datasets including the park inventory, zoning, critical areas, existing land use, aeriels, easements, ownership, etc.;
- Determining parks walkability using buffer tools.

Park Locator

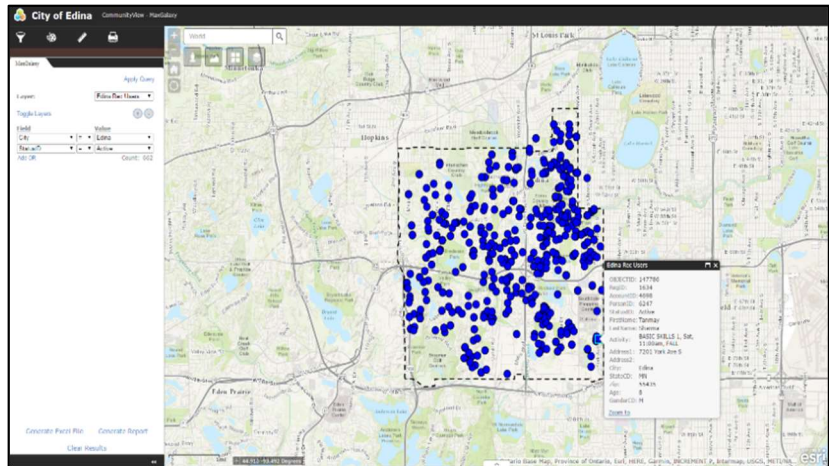
The Esri Parks Locator allows the public to search by amenities, neighborhoods, and type of park. The application is an online configuration that allows the general public to locate park and recreation opportunities in their community from a smartphone, tablet, and desktop computer. This public-facing web browser allows users to search for parks by address or activity, as well as access information about the park within the application. In addition, residents would be able to search for parks based on amenities. For example, users could filter parks by those with basketball courts to figure out what park suits their needs.



Park Locator Application Interface

GIS Integraion with CivicRec

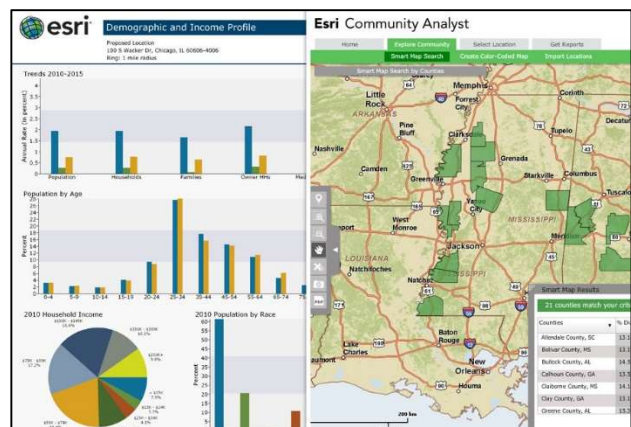
Irvine currently uses CivicRec for the City's recreation management software. The data stored in CivicRec can be visually mapped through integration with GIS. Data from activity registration and membership management can be enhanced through advanced analysis with GIS. In order for the information stored in an application such as CivicRec to be automated and spatially enabled, recreation data in CivicRec need to have addresses as an attribute. A data mining application would be used to extract records stored in CivicRec and geocode them into an appropriate file. Once the systems are integrated, staff could access the data through a GIS intranet portal. GIS would enable staff to map and visualize all program participants and overlay that information with demographic data to analyze demographics and identify underrepresented or under-served populations. Staff would be able to map recreational facility users and pass holders to identify service gaps. Staff could then develop targeted marketing to engage identified under-represented groups.



Mapping Park Users and their Activities

Esri Community Analyst

During departmental interviews, staff noted the importance of social equity and ensuring all Irvine residents have access to recreational opportunities. One tool that could be utilized to conduct advanced analytical work in demographics is Esri Community Analyst. Community Analyst provides users a GIS tool to map demographic, health, economic, and



Esri Community Analyst

business data to identify shortfalls and gaps in service provision. This ensures that underrepresented populations are identified and provided with recreational activities. The Community Analyst application is available as a web tool or can be downloaded as an Add-In into ArcGIS Desktop.

Parks Story Maps

While residents can use the Park Locator Application to find parks around them, a Story Map highlighting some of the City's larger parks (Great Park) could be configured. A Story Map could be developed to include multimedia content – text, photos, video, and audio. For example, GoPro video could be incorporated in a Story Map highlighting trails. Story Maps could also be used to garner community support and funding for new recreational initiatives.



Parks and Recreation Story Map

Great Park Application

Great Park is one of the City's largest projects and is/will have a large impact on the community. The park will have numerous activities, venues, and recreational opportunities. In that regard, a user-friendly mobile application should be developed. Similar to those used commercially (Walt Disney World/Land), an application should be developed that is location aware with navigation, way finding, detailed information about amenities, links to schedules, and links to facility reservations. This application will need to be fully designed and scoped by staff at Irvine and then a contractor should develop the application.

Community Analyst (Community Development)

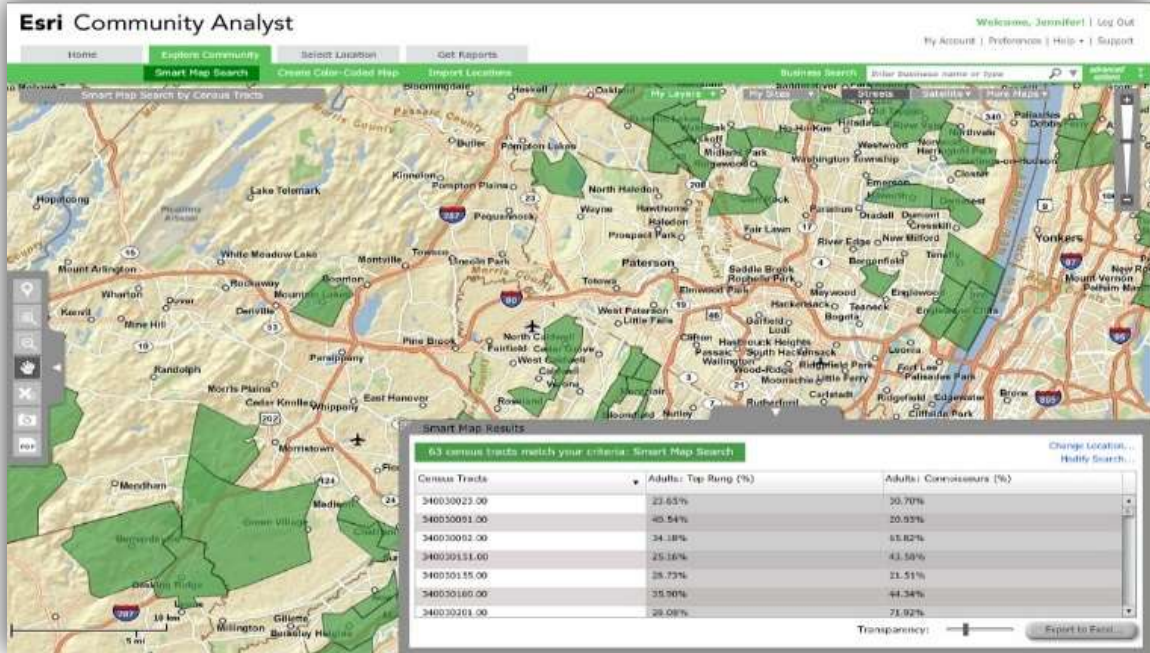
Staff within Community Development could benefit from regularly analyzing demographic data at the neighborhood level. Staff would benefit from the ability to analyze the census data, population projections by census area, and utilize census data to guide future community growth.

Esri's Community Analyst software would assist in providing more detailed community analysis (i.e. the development of housing affordability strategies, identifying income gaps). Community Analyst's features include:

- Specified information and data for the exact area needed—including standard geographies (down to the Census block group level), hand-drawn shapes, or rings, or drive times around a location
- Access thousands of demographic, census, health, crime, and business variables to formulate better policy decisions
- Go beyond basic demographics to really understand the behaviors and preferences of people living in any area using Esri's detailed segmentation profiles

Business Analyst is a similar product and offers extensive demographic variables but is configured for economic development and identifying and exploring consumer and market opportunities. Some of the tools included with Business Analyst are site selection tools, customer segmentation, and detailed economic and consumer maps and reports.

Esri's Community Analyst



Story Map Comprehensive Plan (Community Development)

Community Development staff assists in maintaining the City's comprehensive plan. Story Maps could be deployed to share the information from the plan or some of the sub-area plans that may exist. A Story Map would be an excellent way to depict this data and maps as a living document. This would allow the City to show updated data and maps instead of just a static snapshot. Growth, permitting, updated parcels, updated zoning, and updated land use could all be shared via this application.

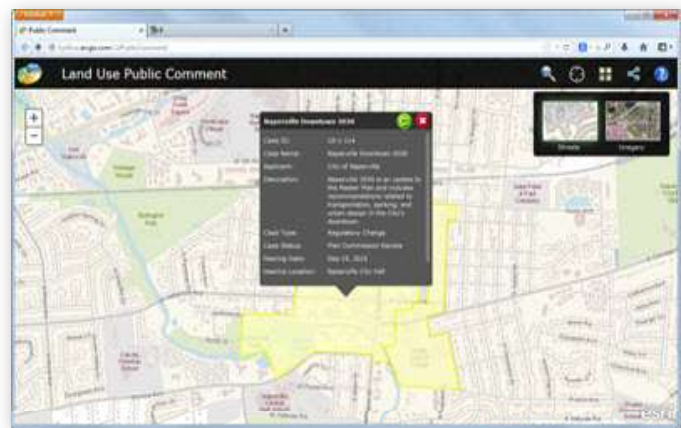
Story Maps would be an effective way to share comprehensive plan information with the public



Crowdsourcing Reporter and Manager (Enterprise)

Currently, the City has several public-facing mapping applications. An important component of providing public information is the capacity to obtain public feedback. Various departments should consider tools that provide residents with the opportunity to provide feedback on topics that require public notification or input, such as re-zonings, variances, code enforcement, and community plan development issues. This could be developed as a widget in a departmental or corporate-wide public-facing browser or could be created separately. Esri has introduced a number of off-the-shelf applications targeted for soliciting community input including Crowdsourcing Reporter/Manager and the Land Use Public Comment applications.

Particularly, the Irvine Code Enforcement team could use Esri's Citizen Problem Reporter, Citizen Problem Manager, and the Operations Dashboard for ArcGIS together to allow online complaint submission with a geographical component. Citizen Problem Reporter is a configuration of the Crowdsourcing Reporter application that would allow the general public to submit Code and Ordinance

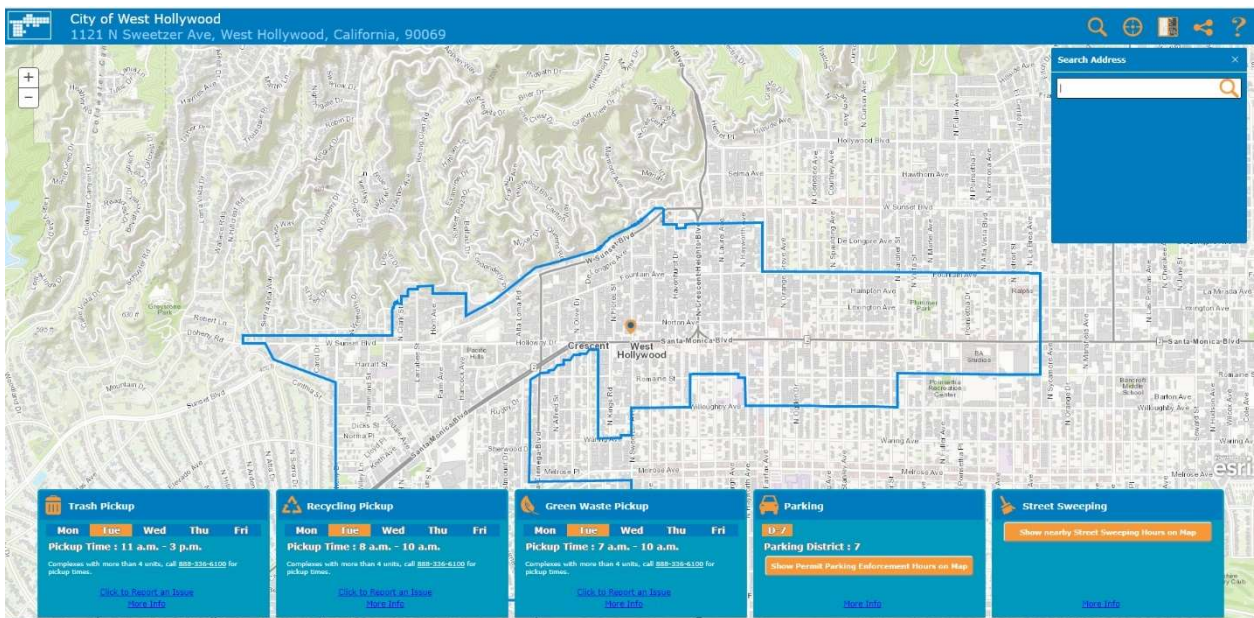


Land Use Public Comment web map

complaints from a smartphone, tablet, or desktop computer. The Crowdsourcing Manager application and Operations Dashboard for ArcGIS can be configured to monitor, verify, and assign reports to responsible officers for resolution. Crowdsourcing Reporter is an Esri GIS based application that can be used by residents to note problems or observations. Users can anonymously submit new reports, review existing reports, and comment or vote on reports or observations submitted by other users. They can also authenticate with their social media accounts and track the status of problems or observations they have reported.

My Government Services (Enterprise)

My Government Services is another configuration of the Esri Web AppBuilder for ArcGIS that can be used by the public to locate a government facility or obtain information about various services in their community. Citizens could use this as a tool to identify public resources like parking information, neighborhood association, and libraries or identify who to contact about a code enforcement issue in their neighborhood. This application is also capable of allowing residents to determine whether or not they live in the City limits or what day their trash and yard waste is collected. This should be an enterprise-wide tool to share information with residents and allow them to find information in one location as opposed to having to view several different maps or web pages.



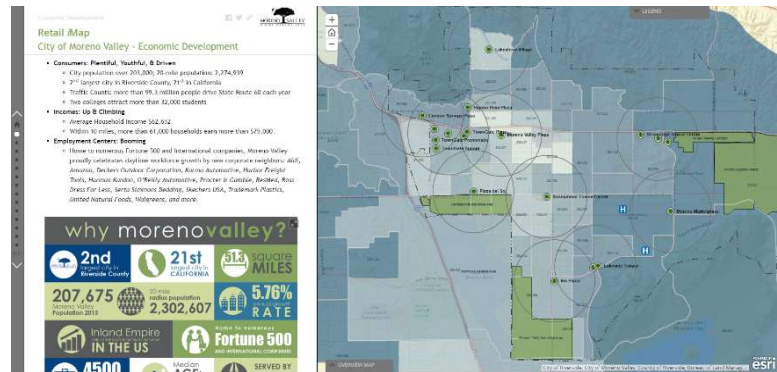
My Government Services Application

Economic Development

Economic Development is a priority for the City of Irvine. As per the Irvine web site, Irvine strives to create a proactive, consistent, and holistic role in the areas of business attraction and retention. In that regard, GIS can play a foundational role in economic development as follows:

Economic Development Public-Facing Web Map

A large component of economic development in Irvine is sharing information about the community and marketing the City. GIS-based tools would allow staff to create dynamic online maps that allow users to access key geospatial information. In addition to displaying static maps, GIS web maps can also be configured to include media such as videos, audio, and pictures and highlight successful projects. Many key assets that Irvine is trying to promote include the City's labor force, access to regional and international markets, strong community diversity, and economic clusters, which can be displayed and explored in-depth through a GIS web map.



Example of an Economic Development Web Map

Data Development

Economic development data is inherently spatial, and the City could benefit from easy access and analysis of spatial data to meet the economic development priorities. Many times, the data needed for this purpose is not all in one place and needs to be gathered and compiled to derive meaningful results. To that end, economic development programs will require additional data creation and development. Staff will rely on various data layers (e.g. demographics, zoning) and base map layers to develop maps and conduct analysis. Successful economic development strategies will depend upon access to a broad range of demographic and geographic information.

GIS allows staff, developers, residents, and other interested parties to access information about available properties, project areas, parking, demographic data, and business lists within the City of Irvine. The consolidation of disparate datasets requires careful database design and development to ensure that the data layers developed from these data sources are accurate.

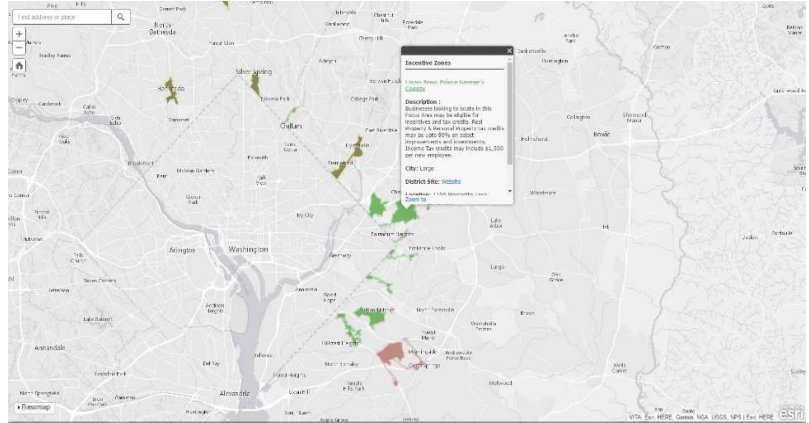
For staff to conduct economic development based spatial analysis, develop site-specific maps, and support an economic development research website, data and data management will be critical. The type of data that is currently maintained, or will need to be acquired from internal sources and external vendors include:

- **Business Data** – that can be used to identify customers or market size including data by industry, sales volume, and employees.
- **Household Consumer Data** – household attributes including age, gender, income
- **Real Estate Data** – that is updated daily with available properties that can be easily geocoded (e.g. address points)
- **Transportation Data** – bus routes, parking, roads, rail, transit
- **Aerial and other types of spatial photography**
- **Census Data** – tract and block group level
- **Business Licensing** – existing businesses
- **Property Data** – dimensions, assessed values, etc.
- **Zoning**
- **Topography**
- **Sales History**
- **Available utilities and Services** – water, sewer, storm water, electric, gas, telecommunications, fiber optics

Some of this data has already been created, is available, and needs to be included in a GIS intranet portal. These datasets need to be examined for accuracy and augmented if datasets are incomplete.

Economic Development GIS Public Web Portal

Typically in cities, there is little available public data on factors businesses and industries (new or relocating) would want to know: zoning districts, flood hazard zones, and available utilities, among others. During the economic development process, economic development zones, potential sites, and other elements are



Example of an Economic Development focused public GIS Portal

selected based on their location and proximity to other locations or distributions of people. Maps can provide contractors, economic developers, and businesses with information from which economic, demographic, and market patterns can be visualized in a way that written reports and statistical tables cannot. Through a public web portal, staff would be able to access the following information:

- **Available Land** – property searches for vacant, retail, office, industrial, etc. properties
- **Demographic Profile** – population, age, gender, income, race, education level, etc. data
- **Education** – information and demographics on local schools and universities
- **Infrastructure** – various utility layers and transportation layers
- **Incentives & Programs** – incentives and programs that encourage economic development
- **Housing Market** – various Real Estate links that provide data on the Housing Market
- **Culture & Recreation** – data for museums, arts, entertainment, attractions, etc.
- **Workforce** – demographics on the local employment labor force
- **Business Parks** – detailed information on business parks including vacancies, buildings data, etc.
- **Government** – government offices and programs in the City

The creation of an Economic Development GIS public web portal with the above functionality will enable public users with the tools necessary to effectively explore Economic Development opportunities within the City.

Enterprise Data Management Plan

City of Irvine | CA

Table of Contents

- Introduction 1
- Data as an Asset (Data Governance and Data Management Strategy) 6
- Building a Data Management Strategy and Program (Data Management, Governance, and Operations) 8
 - City of Irvine Digital Data Management8
- Integration (Data Governance, Management, and Architecture) 14
 - Datasets of Record (Data Quality and Data Operations) 14
 - Tax Parcels 15
 - Address Points..... 19
 - Street Centerlines..... 24
- Data Management Strategy - Data Integration (GIS and IT Systems)..... 26
- Master Data List (Data Management Strategy and Data Operations) 31
- Data Assessment (Data Quality)..... 36
 - Data Management – Feature Classes and Datasets 39
- Data Architecture – Standardized Database Design..... 41
 - LGIM Naming Conventions..... 45
 - LGIM Data Roles and Responsibilities 45
- Data Management – Metadata 47
- Data Assessment (Data Management) 50
 - Parcels 51
 - Street Centerlines..... 54
 - Address Points 56
 - Other Key Data Layers 59
 - The Great Park 59
 - iSHUTTLE..... 61
 - IUSD 62

Overview of Recommendations 63

Appendix A - Master Data List **64**

Appendix B - Data Assessment Table **79**

Introduction

Successful enterprise data management results from a well-executed, multilayer plan. The layers include an appropriate database management system (DBMS), data management standards, assigned data stewards, and assigned user roles. Maintaining the veracity and reliability of enterprise data will require suitable software, knowledgeable staff, a formal data management program, and training for staff in data security and management. Laying out a plan for success not only improves an organization's data security and reliability, but it also will make the organization more efficient in time and cost.

Laying out a plan for success not only improves an organization's data security and reliability, but it also will make the organization more efficient in time and cost.

The City has expressed a need for a data management plan which will minimize costs for data collection and management systems, increase efficiencies, and maintain an organized and secure database structure that is accessible to all departments. These needs can be met through a secure DBMS, implementation of industry standard database schemas, ongoing oversight from a data management team, and training staff in best data management practices.

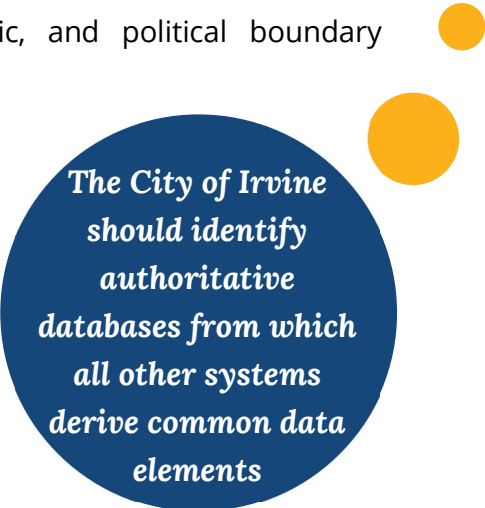
It has been said that 95% of data housed in various local government systems has a geospatial component. This document examines data and data management city-wide but more specifically those datasets that have a geospatial component. This study does not examine all of the City's data and data management but reviews key geospatial data and their relationships with enterprise IT systems and their databases. In that regard, good data management relies heavily on geospatial technology. Key data elements such as address, asset locations, and property data should have their origin in the GIS.

Good data management relies heavily on geospatial technology

The City of Irvine has created, acquired and/or is interested in obtaining a host of GIS data layers. Base map data are geospatial data that represent key geographic features within a specific area; these features are the foundation upon which other geospatial data can be overlaid. A base map can be defined differently, depending on organizational needs. For

some organizations, a base map may be simply land ownership boundaries, while for other organizations, it may be a multi-layered compilation of geospatial data including various layers such as roads, rivers, lakes, wetlands, topographic contours, land use, land cover, land ownership boundaries, and other geographic, demographic, and political boundary information.

It is important for a city to identify authoritative data repositories. Historically, cities have implemented numerous IT systems that house similar data elements such as address. In many cases, the addresses compiled in each system are duplicative and do not rely on a central repository. This results in stovepipes of data that are not standardized. The City of Roanoke, Virginia, did a data assessment and found in excess of 30 databases all housing address and/or property related data elements. In this case, each of the systems had been compiled over time with no authoritative data sources. This resulted in a wide variety of data accuracy and completeness. The City of Irvine should identify authoritative databases from which all other systems derive common data elements. The remainder of this document evaluates existing data, data flow, governance, data architecture, and recommends methods of standardization and optimization.



*The City of Irvine
should identify
authoritative
databases from which
all other systems
derive common data
elements*

Several methods were used to receive feedback and gather the needed information to assess the City's geospatial data and its relation to IT systems. Interviews were conducted onsite with a variety of departments. Data and IT systems were discussed during those interviews. Additionally, follow up conference calls were conducted for additional insight. Also, the City provided a number of databases and documents. The following is a list of the key datasets and documents that were provided.

Databases

- Irvine Geodatabase – Enterprise Geodatabase containing all the spatial data layers for the City.
- Sport Complex Image – A sample image tile of the Sport Complex in the Great Park.
- Sample LAS File – A sample LAS file containing a section of a point cloud.
- Lucity Database – Work order and asset management database for the City.

- GBA GIS – Spatial database for Lucity

Documents

- Addressing and Street Naming Policies and Procedures Document – Document created in 2011, revised in 2013, provides a standardized and expedient method of assigning address to buildings, structures, and parcels, obtaining street name approvals, and obtaining name changes for existing streets and roadways within the City.
- Address Points Document – Document outlining how address points are created and stored within the City’s Enterprise Geodatabase.
- Irvine Uniform Security Code Document – Document created in 2017, is a guide to appropriate addressing (and display of address numbers) for residential single- and multi-family dwellings, single non-residential buildings, special parking facilities, and special recreation spaces.
- ArcGIS 10.6.1 Users Spreadsheet – Excel document with a list of current ArcGIS 10.6.1 users as of 2019
- Building Footprints Document – Document outlines the process of importing building footprints from CAD data, with or without spatial reference.
- Data and Databases Document – Contains a list of all CAD data layers and screenshots of all layers within the Enterprise Geodatabase for the City.
- Digital Submission Requirement for Grading Plans Document – Document created in 2016, provides guidelines for documenting and submitting digital information to the City’s Geographic Information System.
- GIS Data Agreement Document – Document, created in 2019, maintains records of digital data transfer between the contractor and the City.
- Road Centerline Update Procedure Document – Document outlines how new centerline data should be added to the final centerline data layer.
- Create and Update Irvine Centerline and Centerline Point Document – Document outlining the standard operating procedure for copying new centerline features to the final centerline data layer and generating points at intersections.

- Enterprise GIS Design and Implementation Plan Document – Document created in 2003 by ACS and Esri, includes a Needs Analysis (identifying GIS needs), GIS Concept Report (recommendations for data, applications, systems, and staffing), and Implementation Strategy (tasks and schedules).
- Land Record Update Procedure Document – Document outlines what data is associated with the land records data layers and the procedures for adding new data from CAD using COGO.
- Organization Charts – Excel workbook listing related employees by department and flow charts for each Department, listing employees and their roles.
- Update Parcels Procedure Document – Document outlines how to update parcel data for the City.
- TOMTOM Centerline Procedures Document – Document, created in 2014, is a guide for updating spatial data from TomTom centerlines to the City’s road centerline data layer for Public Safety use.
- Tree Inventory Document – Document outlines exporting tree data information from SQL Server to a feature class within ArcMap.

Each of the sections below has headers that indicate the overall topic and then the specific topic. Overall topics include:

- Data Management Strategy – strategies and technique on how best to manage and maintain data;
- Data Management Program – strategies around an overall data management program and/or process;
- Data Governance – topics regarding the availability, usability, integrity, and security of data;
- Data Architecture – strategies regarding models, policies, rules or standards that govern data collection and storage;
- Technology Architecture – issues around how best to store and maintain data from a technology perspective. This topic will be covered in detail in a following document

(Technology Readiness Assessment) and is not discussed here as it would be duplicative;

- Data Quality – strategies dealing with the identification of ways to manage data quality;
- Data Operations – methods and strategies in regards to data maintenance and usage.

Some topics touch on multiple categories.

Data as an Asset (Data Governance and Data Management Strategy)

Data is potentially one of the most important assets of a local government. Millions of dollars are spent on IT systems whose usefulness is contingent on accurate and complete data. Fixed assets at a city are typically tangible. It is easy to see a building, a park, or a truck. If a fixed asset is in disrepair, it is readily discernable – a park bench needs to be fixed, a truck has broken down beside the highway, or city hall needs a new paint job. However, data is not visible nor tangible and in most cases, the quality of the data entered into an IT system is not discernable. Many staff in local government feel that the data entered into an IT system has entered “a black hole”. Examples abound within local government whereby decision makers need information derived from data but are unable to obtain the resultant

Data is potentially one of the most important assets of a local government.

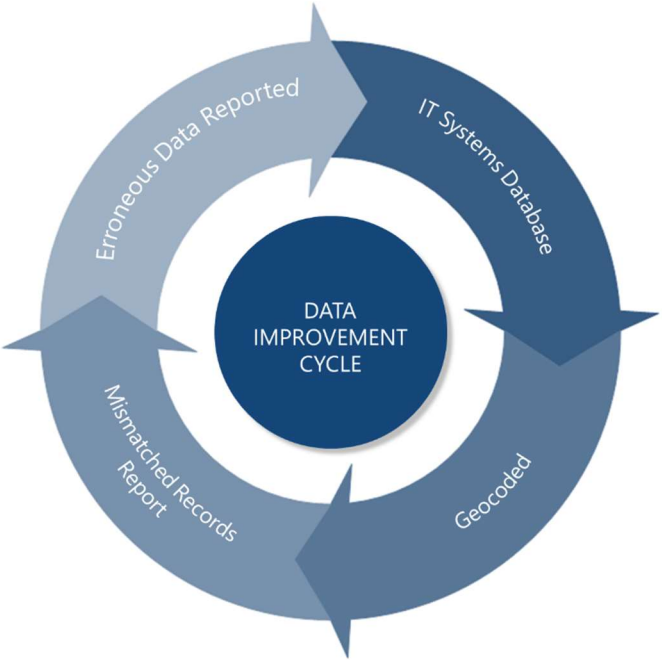
analytics in a suitable form or time frame – i.e. the Police Chief needs all breaking and entering cases within a neighborhood or the Public Works Director needs to know all work orders over the last year on a section of a street.

Also, IT systems are often seen as independent of each other. Data entered in one is also entered in another in many cases. For example, many IT systems in Irvine contain address data that has been derived or entered from different sources resulting in an array of address standards, completeness, and accuracy. No one “source of truth” or “database of record” exists for shared data elements.

The use of GIS within organizations has changed how many organizations operate. With GIS, organizations can now visualize data within IT systems based on their geographic location. As the databases within the IT systems are geo-enabled they begin to be used in more meaningful ways. Additionally, the process of geocoding which results in more pervasive use and analysis of the geo-enabled data reveals data issues. Geocoding itself reveals those records that do not have an accurate geocode (address or parcel). This is a good thing. Those records that do not have a good geocode can be cleaned up to ensure that all of the data in

the IT system has a good address, property number, or asset-id (depending on the system). Data completeness is revealed as more people begin to use the data for meaningful purposes. This creates a data cycle that if handled correctly will result in the databases getting more accurate over time. The graphic to the right depicts a situation whereby GIS and IT systems work together to result in more complete and more accurate databases.

In addition to GIS helping improve IT system databases, the converse is true. As records from IT systems are converted to GIS layers, unmatched records may be a result of the GIS having erroneous or missing data. Therefore, the unmatched report may reveal data issues on the GIS side. In either case, if a clean-up process is in place, then the IT system and the GIS datasets get more and more accurate over time.



Building a Data Management Strategy and Program (Data Management, Governance, and Operations)

Because organizations do not typically “see” data, often no strategy exists to ensure that it is operational and ready for use. Again, fixed assets are discernable. Roads are improved through a series of steps that may include an annual visual inspection resulting in a list of pavement stresses or issues. These issues are then tracked and a work-plan is created to complete capital improvement projects to improve/fix the roads. Data needs the same attention and a strategy for management.

Although this project has a primary focus on GIS, it is relevant to address a data management program overall, because, as discussed throughout this report, GIS should become the primary data viewing and analytical platform for the City. Any municipal data management program should rely heavily on the GIS. As discussed above, GIS allows for data to be geocoded and visualized which was not heretofore possible. Therefore, GIS being the impetus for a data management program is not unusual. The City should create a data management action plan and start a data management program.

City of Irvine Digital Data Management

Today's digital data management and life cycle practices have never been more important. The trend in the geospatial world is a shift towards a centralized geospatial hub of data, decisions, engagement, analysis, visualization, and dissemination. Although this project has a primary focus on geospatial technology, a bigger data picture is critical to the success of the City as a whole. A solid data governance strategy for Irvine will rely heavily on the following smart data practices:

- **Officialize Data Governance Strategy** – Most local governments do not have a data governance strategy. They have systems that contain data and for many of these systems, there is an official or unofficial data entry process. However, a formal strategy and a way of governing the strategy needs to be considered for adoption by Irvine. Key elements for consideration for the Irvine data governance strategy include:
 - **Forming a data management team** – the team should be comprised of key IT staff and data stewards within the organization. Identify roles and responsibilities. Ensure that the team has executive sponsorship.
 - **Adopt a formal data management plan** – what are the goals and objectives for the data management team and data management for the organization.
 - **Identify status** – identify the successes and gaps in data and data management today. Identify designs for current-state and future-state data architecture.
 - **Identify projects** – use agile type review and management to identify data projects to achieve goals.
 - **Consider the future** – where will Irvine be going in regards to the cloud, big data, analytics, integration, and data sharing with the public.
 - **Communicate** – have a communications plan to communicate the purpose, vision, and direction of data management at the City.
- **Data and Databases Standards** - Data standards, data format, definition, and structure continue to be an important part of local governments. In regards to GIS, standardized digital data models are extremely important to local government. Esri's Local Government Information Model (LGIM) and the Next Generation 911 (NG911) standards, as well as Federal Damage Assessment data models, are important for local government success. Before data is acquired, created, or collected, agreed upon data models with business rules should be put into place.
- **Data Acquisition, Creation, and Capture** - Smart real-time and innovative ways of capturing vast amounts of digital data is part of our local government landscape today. This is supported by many classic and traditional data capture practices and principles. Irvine needs to consider new ways of doing business with the idea that

data is a primary asset of the City. Also, GIS will be a primary way of visualizing this data. Traditional methods of data compilation and quality are no longer sufficient as data is being visualized and exposed much more internally and externally. Ways to geo-enable IT systems are discussed further in this document. With this geo-enablement comes ways to ensure data is more exact and accurate. The City will need to include more staff in data management and updates with smart devices. They will be able to visualize all data on their map and if they change assets in the field and/or see errors in data, they need ways to update the data or report the changes in the data. Smart devices are key to growth in Irvine. Sensors in parks, along the roads, and other places will allow the City to gather data about usage, trends, and other key metrics.

- **Data Quality and Value** - The accuracy, validity, reliability, timeliness, relevance, and completeness of data is becoming much more relevant today. New technology and new tools to collect real-time data will become a big part of Irvine's data initiative. The quality of data and especially geospatial data is critical to making informed and life-saving decisions. As mentioned in the previous bullet, the City should have policies and technology that enable a majority of the workforce and even the public to contribute to data maintenance.
- **Data Analysis, Big Data Analytics, and Geo-enabled Processes** – Key to Irvine's data initiatives is the understanding and analyzing the when, where, and what of data. Leveraging the huge asset of data at the City should become a primary focus. Most departments should have a geo-enabled dashboard revealing key data metrics in a live environment. Dashboard statistical reporting practices require new ways of analyzing and presenting geospatial data. Bar charts, line diagrams, pie charts, histograms, scatter plots, dot plots, time series graphs, and trend analysis. Traditional business analytics software has become a trend in local government. Esri has introduced key geo-enabled analytical software (Insights and Operations Dashboard) that should become a key part of the Irvine data visualization strategy. Some cities have gone as far as employing statisticians and big data analytics staff. The City of Vancouver, Washington, has two of these staff in their City Manager's Office.
- **Data Distribution, Dissemination and Propagation** – Having a wealth of comprehensive and accurate data should be a goal and hallmark of the City of Irvine.

However, how the data is leveraged and disseminated is as equally important. Good data that is not used is a wasted asset. A centerpiece of the City of Irvine's overall data program and policy should be how it is used. To that end, tools and techniques for data consumption are critical. The hallmark of a true enterprise, scalable, and sustainable data program in local government is the successful and responsible distribution and dissemination of data using smart desktop, web, mobile, hosted, virtualization tools, cloud technology, and data mashups practices. GIS can play a very large role in the dissemination plan. ArcGIS Hub from Esri has been introduced as a set of tools that enable staff and the public to access and understand data to include its spatial component. This is being recommended for the City of Irvine.

- **Data Maintenance and Upkeep** - The practices and protocols of managing, monitoring, updating, and maintaining digital data is a vital undertaking and responsibility for local government. This has been discussed in previous bullets but is a VERY key component in the data management life cycle. Most staff should be equipped with mobile devices so that they can contribute to the collection and maintenance of key data sets.
- **Data Visualization, Data Interpretation, Representation, Symbolization, and Presentation** - All of the aforementioned lead to the ultimate goal of presenting ideas, concepts, and engaging staff and the public. Traditional local government efforts in this regard have fallen flat. The effort to share data often meant a text-based web page that required interested parties to go and find hidden jewels of data and information. Web sites are replete with PDFs and information presented in a chaotic fashion. Humans are inherently visual by nature. The adage "a picture is worth a thousand words" is so true. The move towards data visualization has been relatively new. Local government has been introduced to new tools that offer data techniques to present data in meaningful ways. Dashboards, story maps, and analytics tools to find patterns within data are becoming increasingly important. The Esri GIS suite has become key in presenting information in meaningful ways and should be a centerpiece of the City of Irvine's data dissemination strategy. It is wise to engage a good cross section of staff when considering presenting data. This should include a PIO (for consistency of message), staff with an eye for marketing and design, technical staff, and the end consumers of the products.

The image below captures all of the above elements in a City of Irvine Data Management Program graphic.



Action Item Summary

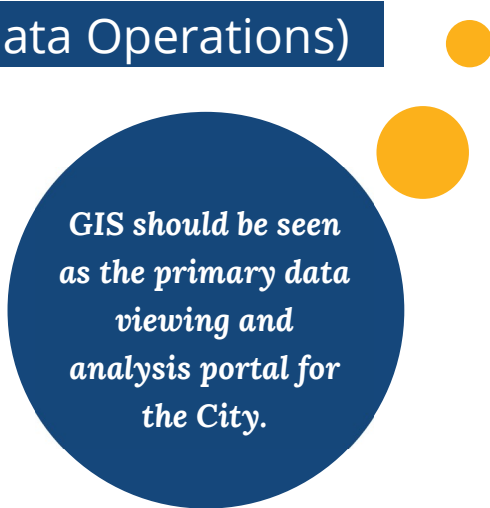
- ❖ Implement a data management program
- ❖ Officialize a data governance strategy
- ❖ Form a data management team
- ❖ Adopt a formal data management plan
- ❖ Adopt data and database standards
- ❖ Identify and prioritize new data
- ❖ Extend the data plan to include many contributors via mobile and public tools
- ❖ Implement data analytics tools
- ❖ Utilize innovative and easy-to-use software tools for data dissemination

Integration (Data Governance, Management, and Architecture)

Data duplication is pervasive in local government. Each system is often viewed independently of other systems. Systems are acquired at different times, from different vendors, and with different data needs. Also, the systems are often implemented by different people with varying levels of knowledge in regard to existing data resources. Most of these systems have common data elements such as address, property number, and/or asset identifiers. It is often difficult to integrate one IT system with another. This results in duplicate data entry and no system of record. Also, the lack of data standards can result in data being entered into systems differently and/or without business rules. The City of Wilson, North Carolina, had an Enterprise Resource Planning (ERP) system that was implemented without enforced business rules or data governance. Once the data residing in the system was needed for other purposes (mapping via GIS), it was discovered that the data was in poor condition. For example, the mall's address had been entered 97 different ways. An initial attempt to match the addresses from the ERP, yielded only a 26% match rate (i.e. 84% of the addresses in the ERP did not match a valid address). The result of the lack of data management and governance is bad data, which in turn results in the inability for staff to make sound decisions based on the data. This, in turn, cost time, money, and in extreme cases has a deleterious effect on the ability to provide effective public safety services. Therefore, it is important for Irvine to identify datasets of record that can be used to store data consumed by all systems and how they will be governed.

Datasets of Record (Data Quality and Data Operations)

As discussed above, data in local government IT systems are often duplicative, replete with erroneous and incomplete data, and not well governed. Additionally, Geographic Information Systems are often wrongly viewed as digital mapping systems with the primary function of automating paper mapping. Instead of GIS being seen through the narrow lens of digital maps, it should be seen as the primary data viewing and analysis portal for the City. The GIS should become a primary



GIS should be seen as the primary data viewing and analysis portal for the City.

data dissemination platform. Also, core datasets should be seen as the database of record for the City from which all other systems pull data. The following are three key base layers, their status, and how they should be managed.

Tax Parcels

For municipal governments, the use, management, and integration of an accurate and up-to-date parcel base map is arguably the centerpiece of a GIS effort. Tax parcels represent a core component layer for modeling land use within Irvine and provide a substantial basis for developing other base map layers.

Several immediate and long-lasting benefits normally derived from parcel base map layer integration include:

- A comprehensive inventory and accounting of all taxable land;
- Comparisons of deeded and calculated (actual) acreage;
- Inventory and determination of government-owned lands and conveyances;
- Verification of tax rolls and incorporation of annexations, providing checks-and-balances of appraisal entity records;
- Provides a strong foundation for control of future growth, zoning, business licensing, land development, and population forecasting.



City of Irvine Parcel Layer

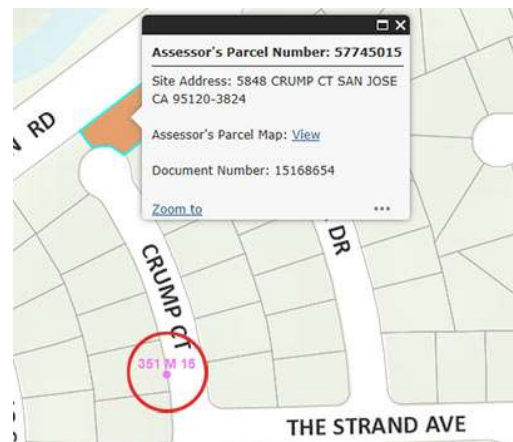
Some of the more tangible and practical benefits emerging from the parcel base map layer include:

- Mailing lists and affected property owner notifications;
- Improved Public Safety response and emergency evacuation planning;

- Readily available property ownership information;
- Viewing and analysis of rights-of-way, variances, setbacks, and zoning as they relate to properties;
- Property valuations and City service expansion/prioritization;
- Floodway management and building code enforcement.

History and Current Status

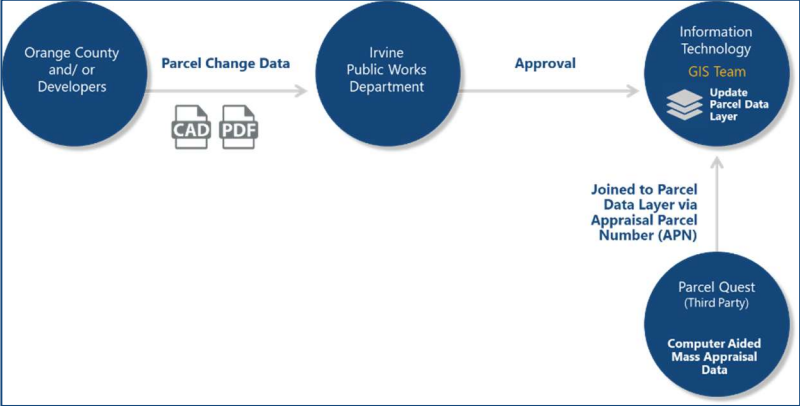
The parcel layer for Irvine was historically mapped by Orange County. The primary need for parcel mapping at Orange County is an inventory of properties for tax roll purposes. Therefore, they are not necessarily as concerned about temporal and positional accuracy as is needed by the constituent cities. Historically, County staff utilized Bentley MicroStation as a Computer Aided Design (CAD) package to maintain a digital map of parcels. Additionally, the Assessor's Office charged for the acquisition of a copy of the parcel map. The City of Irvine decided years ago to maintain their own copy of a GIS parcel layer. Although the staff that made the decision originally to maintain a parcel layer for the City are no longer employed by the City, valid reasons for maintaining a parcel layer at the City are as follows:



Parcel Layer with APN

- Not having to pay the County for updates;
- Parcel layer was not in a GIS format until recently;
- The City is able to control temporal accuracy and ensure that parcel changes are represented on the layer expeditiously;
- The City can improve spatial accuracy as needed.

Because of these reasons, the City has maintained its own parcel GIS layer since the 1990s. Today, the City GIS team in IT maintains the parcel GIS layer for the City. Parcel change data originates from the County and/or developers and is provided to the Irvine Public Works



City of Irvine Parcel Layer Flow

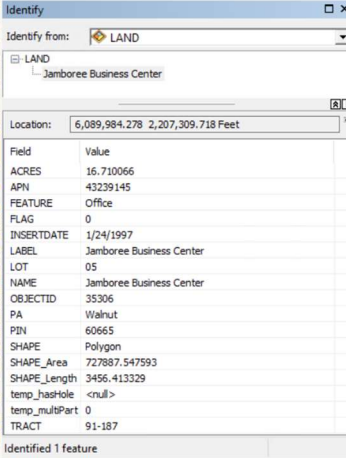
Department as a PDF or Computer Aided Design (CAD) file. The data is then incorporated into the parcel GIS layer upon receipt. The computer-aided mass appraisal (CAMA) data is acquired from a third party (Parcel Quest). The subscription-based service includes property data from the County and value-added data from other sources. Once a year the County releases an updated parcel layer. The City GIS team compares this layer to the City layer to identify, investigate, and correct any discrepancies if needed. The Parcel Quest file is linked to the GIS layer by a unique assessor's parcel number (APN).

Recommendations

The assessment data is important for a number of IT systems at Irvine. The permitting system (Eden) relies on addresses and accurate parcel information. The OnBase document management system records can be linked to GIS by parcel number or address. Other systems like Edenfor permitting rely on property related data. The following are key recommendations for the parcel GIS layer:

- The City should continue to maintain the dataset until a process is established with Orange County whereby data can be received in a timely fashion and data is kept up-to-date.
- The City should open dialogue with Orange County about its parcel mapping process in an effort to receive the parcel GIS data at low cost/no cost.

- If the City can reach an acceptable agreement with the County, the City should discontinue maintaining its own parcel data layer.
- The parcel data layer and property data from Parcel Quest should be the database of record for the City. All other systems should derive needed assessment information through a link with the data via APN.
- Systems that need property information, but do not have an APN but do have an address, should link to assessment data through an address matching process. The address should be address matched to the City GIS address points. A spatial overlay between these address matched records and the parcels should be done to assign appropriate assessment data to the address matched records. The resultant data can then be pushed back to the originating IT system through a unique identifier originating from the IT system records. This can be done on an as-needed basis and automated through the use of programmatic tools.



The screenshot shows a 'Identify' window from a GIS application. It displays a tree view with 'LAND' expanded to show 'Jamboree Business Center'. Below this, a 'Location' field shows coordinates: '6,089,984.278 2,207,309.718 Feet'. A table lists various fields and their values for the identified feature.

Field	Value
ACRES	16.710066
APN	43239145
FEATURE	Office
FLAG	0
INSERTDATE	1/24/1997
LABEL	Jamboree Business Center
LOT	05
NAME	Jamboree Business Center
OBJECTID	35306
PA	Walnut
PIN	60665
SHAPE	Polygon
SHAPE_Area	727887.547593
SHAPE_Length	3456.413329
temp_hasHole	<null>
temp_multiPart	0
TRACT	91-187

Assessors Data Available Via GIS

Action Item Summary (Parcels)

- ❖ Continue to maintain parcel layer
- ❖ Open dialogue with Orange County about a better parcel process
- ❖ Consider discontinuance of parcel maintenance
- ❖ Ensure the City continues to receive the most timely property data (currently Parcel Quest)
- ❖ Use GIS to ensure that IT systems have complete and accurate property data

Address Points

For years, municipalities all over the country have been using table database structures to update and maintain addresses. Organizations often had many disparate address datasets feeding multiple computer applications. Often entry of this data was not regulated. Therefore, addresses were being entered free form without any standards. Instead of clean, valid addresses, an addressing nightmare was created. This old-world method is often cumbersome, allows for error in data entry, and causes difficulty in enforcing data standards.

Problem with free-form data entry and lack of standards:

Example of **One** Address Entered Incorrectly **Nine** Different Ways

Street #	Street Prefix	Street Name	Street Type	St Post Qualifier	Unit #
315	N	Wackerly	St	Suite	6
315		North Wackerly	Street		STE 6
315-325	N	Wackerly	St	Ste	6
315	N	Wackerly Street			Suite 6
315	North	Wackerly	Street	Suite 6	
315-317	N	Wackerly St		Ste 6	
315		N Wackerly	St	Ste	6
315	N	Wackerly	Str	Suite	6
315	North	Wackerly St	St	Ste 6	

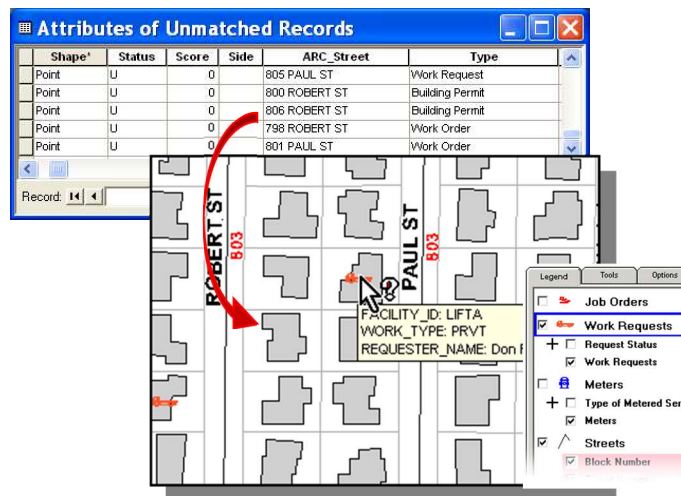
Example of the Same Address Entered **Correctly** Using Data Standards

Street #	Street Prefix	Street Name	Street Type	St Post Qualifier	Unit #
315	N	Wackerly	St	Ste	6

Are accurate address points and street centerlines really that important?

Why do we need address points that are so accurate? Why are we so concerned with cleaning up the address database? An organization is often faced with the challenge of accurately mapping the location of work orders, emergency dispatch, work requests, building permits, and service calls throughout a city. If an accurate address point layer does not exist, unfavorable results will occur when trying to map building permits, work requests, or other data against that address. Lack of an accurate address point layer will often result in unmatched records. The organization then needs to invest additional time and resources attempting to determine the location of the record – manually.

Why aren't my work orders matching correctly?



Example of Unmatched Work Orders and Building Permits Due to Inaccurate GIS Address Data

If we have good street centerline data, why do we need an address point layer?

Having an accurate street centerline layer is vital, but relying solely on street centerline data to map addresses has some limitations. The geocoding (address matching) process with street centerlines uses a mathematical algorithm to place addresses at an offset along the street centerline



Addresses Matched to Street Centerlines (less accurate)



Addresses Matched to Address Point Layer (very accurate)

proportionate to the attributed address range. This results in address points that may or may not be placed next to the correct structure. If, however, an accurate address point layer is used to match addresses, a much more accurate placement will be realized.

History and Current Status

The City has a standing addressing committee with members representing various departments (Police, Fire) and external organizations (Post Office). This committee makes recommendations on the naming and numbering of new addresses. Additionally, the City has an Addressing and Street Naming Policies and Procedures document used to guide the City in assigning addresses. As described above, a GIS layer depicting the location of each specific address in the City with associated attribution is a critical and highly-important layer. The City created the address point layer years ago. Currently, the GIS team in IT maintains the address point layer. Many of the multi-tenant dwellings have addresses stacked on the centroid of the building instead of the actual unit location. Overall, a majority of the City addresses have been captured in this layer.



City of Irvine Address Points

One of the common challenges faced by many organizations is determining the appropriate time to create an address point (as soon as it is proposed or when it is approved). On the surface, it would seem logical to wait until the address is approved. However, public safety

often has to respond to a site before the final approval of the address has been granted. Therefore, the City should consider alternatives to waiting for approval.

Recommendations

As part of the recommended database design discussed later in this document, the City should evaluate the address points and further refine the database design to be National Emergency Number Association (NENA) Compliant. The furtherance of the address data model should embrace industry best practices/standards. NENA has published documents detailing the standards that should be utilized for Automatic Location Identification (ALI) data exchange between service providers, database management system providers, a GIS data model, a data dictionary, and formats for data exchange between the ALI Database and PSAP Controller equipment. These established standards should set the foundation for this project.

NENA Standard Data Formats for ALI
Data Exchange & GIS Mapping
NENA 02-010, Version 8.2, June 10, 2009

EXHIBIT 6
VERSION 2.1 FORMAT FOR DATA EXCHANGE

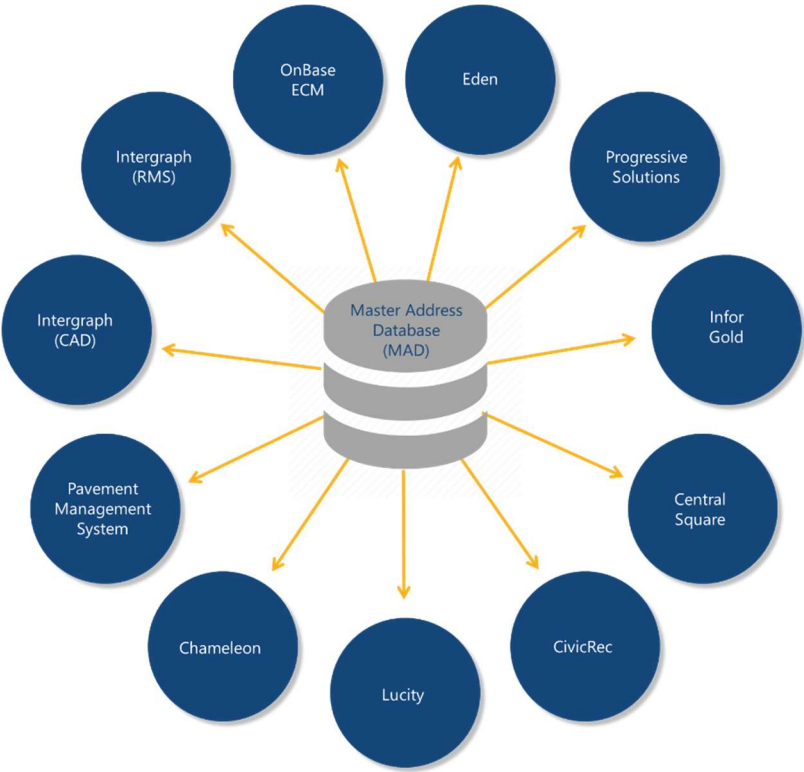
FIELD NAME	POSITION	BYTES	TYPE	DESCRIPTION
Function Code	1	1	A	Type of activity the record is being submitted for. Valid entries: C = Change D = Delete I = Insert U = Update N = Unknown
NPA	2-4	3	N	Three-digit area code of the Calling Number.
Calling Number	5-11	7	N	Seven-digit telephone number of the Calling Number.
House Number	12-21	10	AN	House number. The field should be space filled if no house number is available. <i>NOTE: Although the House Number field is ten characters, it is understood that telephone companies may only support up to 9 characters.</i>
House Number suffix	22-23	2	AN	House number extension (e.g. 10). The field should be space filled if no suffix applies.
Prefix Directional	24-27	4	A	Leading street direction prefix. The field should be space filled if no prefix applies. Valid entries: N S E W NE NW SE SW
Street Name	28-47	20	AN	Valid service address of the Calling Number.
Street Suffix	48-51	4	A	Valid street abbreviation, as defined by the U.S. Postal Service Publication 28, Appendix C (e.g. AVE).
Post Directional	52-53	2	A	Trailing street direction suffix. The field should be space filled if no suffix applies. Valid entries: N S E W NE NW SE SW
Community Name	94-125	32	A	Valid service community of the street name/house number as determined by the ANSAC.
State	126-127	2	A	Alpha state abbreviation (e.g. TX).
Location	128-147	20	AN	Additional address information (two formatted) describing the exact location of the Calling Number (e.g. Apt 218).
Customer Name	148-219	72	AN	Subscriber name associated with the Calling Number. Preferred format for an individual customer name (not a business) is: Last, First and, optionally, a suffix which may be generation (Jr, III) and/or title (Phd, Esq, M.D., Honorable (Mr., Mrs., Ms.)) should not be included as part of the name.

Version 8.2, June 10, 2009 Page 28 of 76

NENA Standards

The City should incorporate the new addressing guidelines and ensure that the address GIS layer in NENA and Next Generation 911 compliant. Furthering the development of an addressing geodatabase model will provide Irvine with clear guidelines for data development, consumption and distribution of this data to the entire user base. The data model is a representation of all data types, conventions, range values, data structures and relationships that are used when storing geospatial address data.

Additionally, the address GIS layer should become the master address database (MAD) for the entire City. The MAD should be used to feed other systems so that every address is validated from a pick list. This will ensure data integrity within each of the systems. Most of the existing systems are established and using the MAD for them may be challenging. However, as each system is upgraded or replaced, they should be required to assimilate data from the MAD.



City of Irvine Master Address Database

Action Item Summary (Address Points)

- ❖ Create a NENA compliant address point geodatabase and migrate existing data into the new model.
- ❖ Ensure that the stacked addresses are moved to their exact location.
- ❖ Do a full data audit on the master address database to discern missing addresses or those that need augmentation.
- ❖ Begin entering addresses into the database before they are approved to accommodate public safety needs. Note these as pending until approved.
- ❖ Begin to use the master address database as the system of record and feed other IT systems.
- ❖ Ensure that any new IT systems require the use of the master address database.

Street Centerlines

Street centerlines are versatile in their support of local government operations. Generally, the centerlines represent the center of a roadway. Some divided highways may be depicted by two centerlines – one for each direction of travel. Each street is broken up into segments starting and ending at roadway intersections. At each intersection, multiple line segments may meet from multiple streets. Each segment contains additional information (attributes) such as the name of the street and the address ranges along that street. Many other attributes may also be stored with this data. Street centerlines may support a number of important functions within the GIS:



Example Street Centerline Layer

- Road name labels
- Road classification (highway, arterial, surface, etc.) support symbology
- Address ranges support geocoding
- Linear Referencing System (LRS) support mile marker geocoding
- Vehicle routing, when one-way roadways are attributed
- Drive-time modeling, when speed limits are integrated

History and Current Status

The street centerline layer for the City is maintained by the GIS team in IT. It is set up as a single carriageway layer with attribution indicative of the road names and street ranges. The data layer is not set up for routing. Historically, address matching was done using street centerlines. However, most organizations (Irvine included) now use address points as the primary way to match address data to the earth's surface. Therefore, its usefulness has

waned. However, the layer is mandatory for routing and scheduling algorithms. Additionally, E-911 systems often make closest unit recommendations based upon drive time by using a street centerline layer.

Recommendations

Action Item Summary (Street Centerline)

- ❖ Consider making the street centerline layer routable when the functionality is needed. This means the inclusion of key elements such as turn impedances, divided highways, and other impedances.
- ❖ Maintain a separate layer for pavement management purposes as it requires breaking the streets at intervals that do not lend themselves to other purposes.

Data Integration GIS and IT Systems (Data Management Strategy)

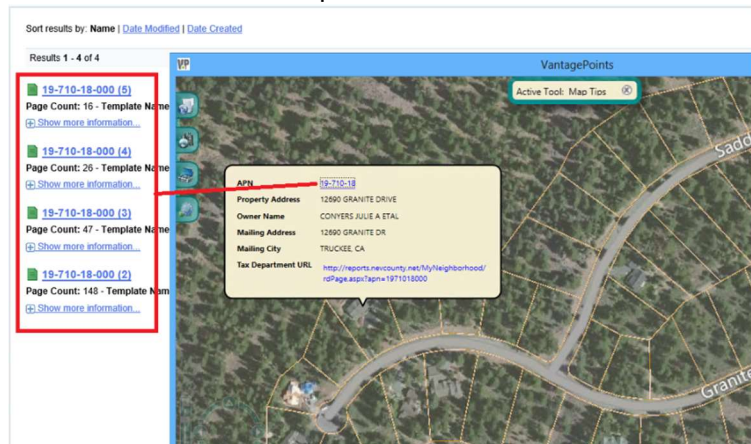
As aforementioned, GIS in Irvine should be seen as a window into all data at the City. It should be the primary visualization and analytical portal for all departments. This requires a combination of data, software, and backend tools. Many cities are myopic in regards to the wealth of existing data they have created and invested millions of dollars to maintain. This data resides in existing IT systems. Almost all of the data in the various IT systems at Irvine have some type of geographic component. The following is a list of the major IT systems/databases in place in Irvine and the geographic elements/attributes that allow for geolocating the data.

System	Primary Use	Integration Notes	Recommendations
OnBase ECM	Document and Records Management	OnBase has an Esri linking application that the City has acquired. This links records to the earth's surface via geocoding and placement on the digital map.	Implement the GIS link from OnBase.
GoEnforce	Code Enforcement	Has field for address and property related information.	Setup an automated geocoding application to geoenable data continually.
HostComplicane	Code Enforcement	Uses address data	Setup an automated geocoding application to geoenable data continually.
Progressive Solutions	Business Licensing	Address match address against address points to generate GIS layer of BL and other data (Certificates of Occupancy).	Setup an automated geocoding application to geoenable data continually.
Eden	Permitting	Address match address against address points to generate GIS layer of Permits. Can view by status, type, and other variables.	Setup an automated geocoding application to geoenable data continually.

System	Primary Use	Integration Notes	Recommendations
Central Square	Finance	The strictly financial data such as Payroll, Accounts Receivable, Accounts Payable, etc. do not need to be geocoded. However, any records on customers should be considered.	If needed, set up geocoding application. Lower priority.
CivicRec	Parks Users	Geocoding users of parks and programs reveals patterns and service usage patterns. Used in conjunction with demographic data allows for optimization of parks and programs.	Setup an automated geocoding application to geocode data continually.
Lucity	Asset Management	Asset data is linked to the GIS via a unique asset id. This takes an understanding of both systems and resources to ensure that the systems stay in sync.	Lucity provides tools to assist with maintaining a link between GIS and Lucity. Overall asset data should be stored in Lucity and scripts should be put into place to link the Lucity data for consumption via various GIS applications.
Chameleon	Animal Control	Animal control cases should be linked via address to address points. This would allow staff to view open cases, high volume areas, areas in need of education, and potential trends.	Setup an automated geocoding application to geocode data continually.
Pavement Management System	Public Works	Pavement management systems are linked to GIS via a unique pavement segment number. Typically, cities maintain a street centerline file specifically for pavement management and one for routing and emergency services.	Linked via unique id. Often called a pavement-id or something similar.
Intergraph	Computer Aided Dispatch (CAD)	Intergraph requires the conversion of address points and other address data to their proprietary format. The City is considering a new system.	Modern CAD systems can read data directly from the Esri geodatabase without conversion. They locate address calls by address matching to address points and use street centerlines for

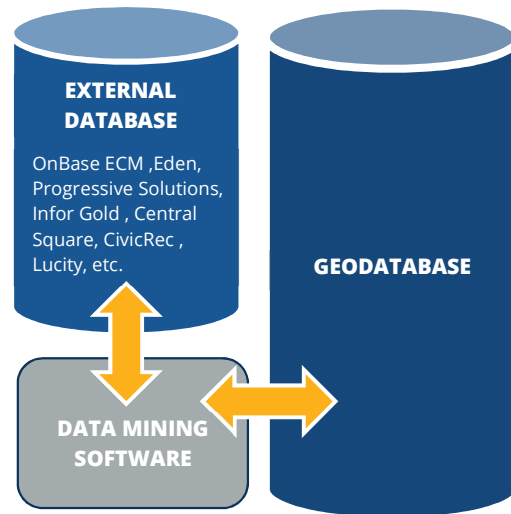
System	Primary Use	Integration Notes	Recommendations
			routing and closest unit recommendations.
Intergraph	Records Management System (RMS)	Address matching of records is done to address points for crime analysis and pattern detection.	An automatic geocoder should produce a GIS layer available 24x7 of incidents as soon as they are logged.

Most of these systems contain the data of record for their specific focus. However, most of the data can have much more pertinence and usability if it were made available as GIS layers. Additionally, the address matching process reveals data that is erroneous, identifying opportunities for data clean-up projects and standards of data entry. Many organizations make the geo-enabling of data too complex or ignore it altogether. Off-the-shelf software exists, that allows an organization to automatically geo-enable data at set intervals. The result is that data is entered into the IT system is automatically geocoded and made available within a GIS layer for visualization and analysis.



Document Management System Data Linked by APN

As detailed in the Needs Assessment document and reiterated here, data mining can be used to extract data from existing databases by geocoding addresses or mapping coordinates and placing the results into a relational database (Oracle or SQL). The extracted data can then be stored and managed within the database. The resulting tables can be made available for IT professionals and analyzed using application software. The analyzed data can then be presented in a useful format such as a graph or table. An on-premise deployed intranet mapping application should then be used as a front end for visualization of the data. The graphic demonstrates in a generic sense the process of using data mining middleware to extract data.



Data Mining Process

Several companies have developed application software such as FME by Safe Software that is capable of overcoming format and data model barriers to moving data into various formats so that the corporation can leverage the data. In addition to FME, Esri offers a similar solution called ArcGIS Data Interoperability. Also, Esri business partners have created applications for this purpose (i.e. GeoMax from Geographic Technologies Group).

Once the above information is maintained as digital data, it can be spatially enabled for use in the City GIS and used like any other GIS layer. Staff needs to make sure they have the data stored with necessary characteristics (XY coordinates or addresses) to geo-enable this data. Recording data with these characteristics will allow it to be integrated into existing records or geo-enabled. The integration of the enterprise GIS with other enterprise-wide information systems will improve staff efficiency and increase communication, coordination, and collaboration across the organization.

Action Item Summary

- ❖ Acquire a geo-enablement software package
- ❖ Systematically set up the software to geo-enable each IT system
- ❖ Create a non-matched report

- ❖ Clean up IT system or GIS data based on the non-matched report

Master Data List (Data Management Strategy and Data Operations)

A common gap faced by most agencies is a viable and effective way to communicate and educate the organization about the data resources that exist. A number of departments at Irvine identified that they had limited visibility into what data was available and into the data used/maintained by other departments. Almost all cities struggle with an effective data awareness dissemination method. The below discusses a GIS Master Data List but the concept should be extended to include key IT datasets that are not housed in the GIS.

A GIS Master Data List is, as the name implies, a listing of up-to-date information pertaining to all of the geographic and related datasets that are available for reference or utilization within the overall enterprise GIS ecosystem. Master Data Lists are usually extracted from a larger body of information referred to as GIS metadata. In the simplest of terms, metadata is information about data. Similar to a library catalog record, metadata records document who, what, when, where, how, and why of an enterprise GIS data resource. Among other things, metadata provides descriptive information maps, geographic data, imagery, and other location-based data resources. Geographic metadata (discussed previously) can provide answers to questions such as:

- Who developed the data?
- When was the data collected/created/updated
- How was the data processed into its current state?
- How are the data attributes defined?
- In what formats are the data available?
- How does one obtain the data?

The information in the metadata provides context for the data and supports the effective application of the data. Metadata is an important resource for system users that need

guidance on the fitness or suitability of a dataset to support analysis or render decisions based on the contents of a dataset.

A mistake many organizations make is the belief that metadata is their Master Data List. This is erroneous. Metadata provides a wealth of detailed information that is necessary to understand the detail about a layer. However, most users just need to know if a layer exists and some basic information about that layer. Metadata is too cumbersome for a casual user. Additionally, often a Master Data List (MDL) is created by technical staff who do not have a sense for creating something consumer ready. Including a person on an MDL team that has a sense of marketing techniques is important.

An MDL should be graphically pleasing and presented in such a way that a complete novice can understand what is being presented. A typical MDL might contain the following information:

- Entity Name
 - **i.e. Roads**
- Entity Description
 - **I.e. comprehensive road layer of all roads in Irvine maintained by the GIS Team in IT. Contains accurate address information and can be used for routing.**
- Entity Type
 - **Point, line, polygon or composite – i.e. line**
- Entity Status
 - **i.e. maintained daily and fully complete**

Users need access to a digital version of an MDL and a hard copy if needed. The MDL needs to be grouped in such a way that a novice user can quickly find the data they are seeking. Example groupings could be:

- Infrastructure-Related Data
- Aerial Photography or Remotely Sensed Data
- Public Safety Related Data
- Planning Related Data
- Environmental Related Data
- Parks Related Data
- Etc.

On the digital version, a link could be embedded that would take the user to the location of the data layer. The MDL should have check boxes beside each layer so that the MDL can be used for users to select the data they want to consume in their various applications. An example MDL is provided on the following page.



Planning

DATA SET	UPDATE FREQUENCY	LINK TO DATA
Planning Data Layer 1	Monthly	<input type="checkbox"/> .PDL1
Planning Data Layer 2	Daily	<input type="checkbox"/> .PDL2
Planning Data Layer 3	Quarterly	<input type="checkbox"/> .PDL3
Planning Data Layer 4	N/A	<input type="checkbox"/> .PDL4
Planning Data Layer 5	As-Needed	<input type="checkbox"/> .PDL5

Parks

DATA SET	UPDATE FREQUENCY	LINK TO DATA
Parks Data Layer 1	Monthly	<input type="checkbox"/> .PDL1
Parks Data Layer 2	Daily	<input type="checkbox"/> .PDL2
Parks Data Layer 3	Quarterly	<input type="checkbox"/> .PDL3
Parks Data Layer 4	N/A	<input type="checkbox"/> .PDL4
Parks Data Layer 5	As-Needed	<input type="checkbox"/> .PDL5

Public Safety

DATA SET	UPDATE FREQUENCY	LINK TO DATA
Public Safety Data Layer 1	Monthly	<input type="checkbox"/> .PSDL1
Public Safety Data Layer 2	Daily	<input type="checkbox"/> .PSDL2
Public Safety Data Layer 3	Quarterly	<input type="checkbox"/> .PSDL3
Public Safety Data Layer 4	N/A	<input type="checkbox"/> .PSDL4
Public Safety Data Layer 5	As-Needed	<input type="checkbox"/> .PSDL5

Example Master Data List

A variety of approaches can be chosen to deliver the MDL to user desktops. Utilizing a web browser to provide this information is a popular approach which can employ a SQL RDBMS as the backend for record storage and retrieval, ASP.Net for the web tier, and finally HTML5 as the front end and user interface. Hyperlinks can be embedded in the tabular data which can be selected to retrieve additional information pertaining to the MDL items. A comprehensive MDL will improve the utilization of the enterprise GIS by ensuring that system users are aware of all available resources and understand the uses and limitations inherent in the data contained within the enterprise GIS.

Additionally, an ongoing data awareness education game plan should be established and implemented. This should include:

- Annual MDL workshops
- Online MDL brief training video
- Annual customer feedback survey on the effectiveness of the MDL

Action Item Summary

- ❖ Form a sub-committee to review metadata and the MDL. Meet as needed. Include staff from other departments.
- ❖ Creation of a user-friendly Master Data List (Hardcopy and Digital)
- ❖ Annual MDL and Metadata workshop
- ❖ MDL tutorial video
- ❖ Annual user survey and feedback on the MDL

Data Assessment (Data Quality)

Many of the City's GIS data layers are the dataset of record for the City. Staff should become more and more reliant on the City's GIS to make decisions. As aforementioned, GIS should become a primary portal for accessing and viewing data. IT system data should be geo-enabled and used in tandem with traditional GIS layers so that staff or the public can satisfy most of their data needs via user-friendly GIS portals.

As GIS use expands it becomes more critical that the data is accurate and the data accuracy is understood. In that regard, it is recommended that the City conduct a data assessment every year. For this study, a data assessment was completed on the data provided by the City, including geometry checks and an attribute assessment. Key base layers were thoroughly reviewed and their assessment is included below. Additionally, suggestions that may be applied to all data layers within the database have been identified, including metadata practices and verifying spatial accuracy of data. The following sections include the results of the assessment of the following key base layers and the geodatabase:



*It is recommended
that the City
conduct a data
assessment every
year.*

- Parcels
- Street Centerlines
- Address Points

Additionally, data from the following geodatabases were assessed:

- Great Park
- iSHUTTLE
- IUSD

Geometry checks were performed using Esri's ArcGIS Data Reviewer tool. Esri's ArcGIS Data Reviewer performs data quality checks, detecting anomalies within features. The following geometry checks were performed on all feature classes in the geodatabase by shape type:

- Polyline Analysis:
 - Invalid Geometry
 - Duplicate Vertex
 - Cutback
 - Multipart
 - Dangle
 - Orphan Checks

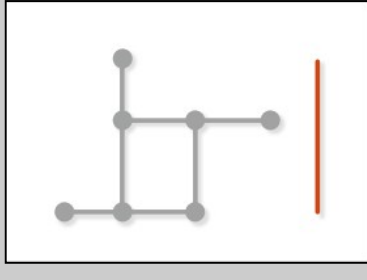
- Polygon Analysis:
 - Invalid Geometry
 - Duplicate Vertex
 - Cutback
 - Multipart Checks

- Point Analysis:
 - Duplicate Geometry

The table below elaborates on the checks performed. The summarized results from the Data Reviewer are supplied in Appendix B. The Data Reviewer dataset can be made available to the City if they wish to review these results in more detail.

Additionally, an attribution check was also completed for each feature. Each field was scanned for NULL or blank values, and a percentage of completeness was reported. A sample of the results are included in the following sections. The complete table of geometry and attribution anomalies for each feature class has been provided in Appendix B. A Master Data List (MDL) was created and is supplied in Appendix A. This will be expanded on in detail in the “Master Data List” section below, however it will be referenced throughout the “Data Assessment” section.

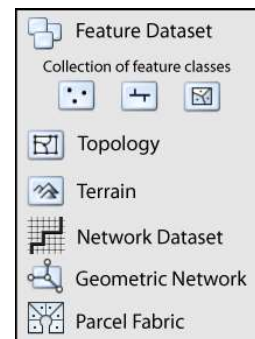
Data Reviewer Checks														
Anomaly Type	Description													
Invalid Geometry	Finds features whose geometry is empty as well as features with empty envelopes.	<table border="1"> <thead> <tr> <th>OBJECTID</th> <th>SHAPE</th> <th>FCSUBTYPE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>POLYLINE</td> <td>AQ040-BRIDGE LINE</td> </tr> <tr> <td>2</td> <td>POLYLINE</td> <td>AQ040-BRIDGE LINE</td> </tr> <tr> <td>3</td> <td>NULL</td> <td>AQ040-BRIDGE LINE</td> </tr> </tbody> </table>	OBJECTID	SHAPE	FCSUBTYPE	1	POLYLINE	AQ040-BRIDGE LINE	2	POLYLINE	AQ040-BRIDGE LINE	3	NULL	AQ040-BRIDGE LINE
OBJECTID	SHAPE	FCSUBTYPE												
1	POLYLINE	AQ040-BRIDGE LINE												
2	POLYLINE	AQ040-BRIDGE LINE												
3	NULL	AQ040-BRIDGE LINE												
Multipart	Searches for features with more than one part.													
Duplicate Geometry (Vertex)	Finds features of the same geometry type that are co-located.													
Cutbacks	Identifies segments where the angle between segments in a polyline is below a specified minimum value.													
Find Dangles	Within a database, topology finds polyline features that have nodes that are within a tolerance.													

Orphan	Finds single polyline features that are not connected in the database topology.	
---------------	---	---

Data Management – Feature Classes and Datasets

The City could benefit from implementing standard practices and data accuracy checks on most or all of the feature classes within the GIS database. First, it is beneficial to review some GIS database nomenclature as follows:

- **Feature Classes** - homogeneous collections of common features, each having the same spatial representation, such as points, lines, or polygons, and a common set of attribute columns, for example, a line feature class for representing road centerlines.
- **Feature Dataset** - a collection of related feature classes that share a common coordinate system. Feature datasets are used to spatially or thematically integrate related feature classes.



There are 241 stand-alone feature classes (not within a feature dataset). Where possible, feature classes should be housed in feature datasets. Feature datasets organize feature classes that are thematically and spatially related, and allow users to build topology, and network or geometric networks. There are at least 174 feature classes that follow a naming convention which would suggest they could transition to five separate feature datasets. These feature classes begin with:

- ADMIN
- EMER
- ENV

City of Irvine | CA

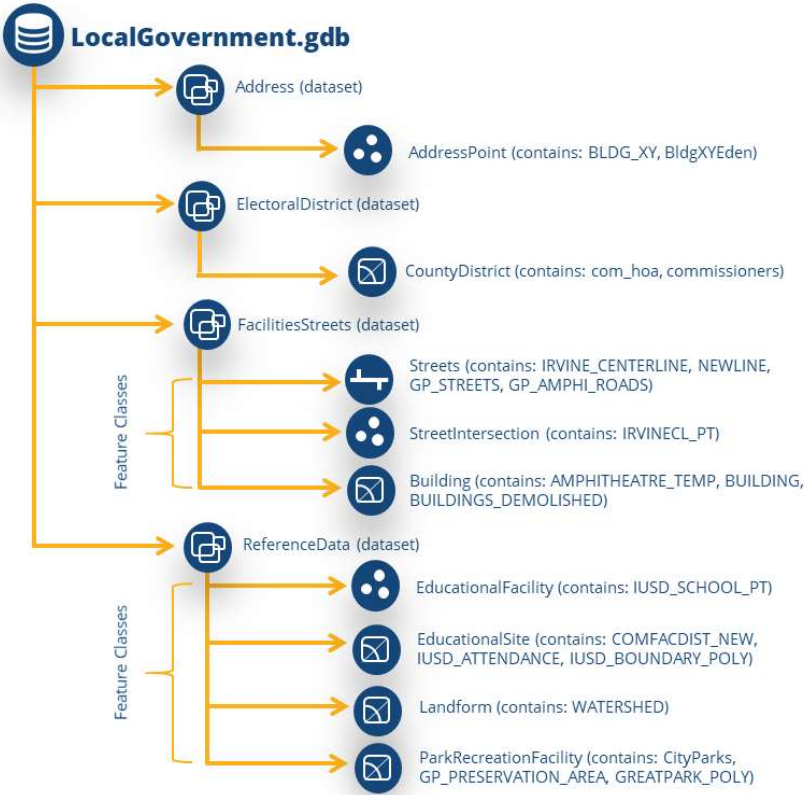
Enterprise Data Management Plan

- GP
- ZONING

The City should consider the appropriateness of grouping these feature classes in respective feature datasets based on their naming.

Data Architecture – Standardized Database Design

While considering data structures, the City should consider implementing an Irvine specific version of Esri’s Local Government Information Model (LGIM) as a standard data schema. Implementing a standardized data schema reduces redundancy and data duplication and improves data access by establishing standard naming conventions and domains. The LGIM contains a variety of logically defined feature datasets and feature classes that are common to most local government’s spatial data needs. A data layer has the potential of being logically assigned to more than one feature dataset; for example, TIGER roadways from the Census Bureau could be potentially assigned to either the ‘Facilities Streets’ dataset or to the ‘Demography’ dataset. However, GIS layers that are migrated into the LGIM should be matched as closely as possible to the representative feature class in the LGIM design (LGIM metadata is useful in making this determination). This is especially important when using the LGIM in conjunction with ArcGIS for Local Government. The LGIM can and should be modified to fit the specificity of the City of Irvine. Organizations just beginning their GIS program can use the LGIM out-of-the-box. However, established GIS programs have a multitude of GIS layers already established which cannot be readily moved into the LGIM.



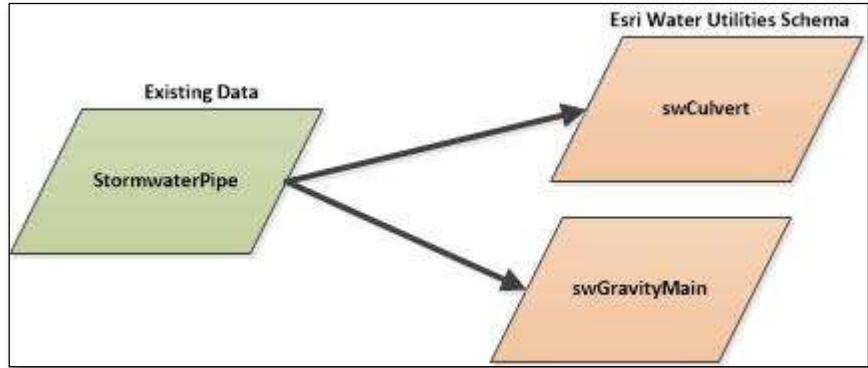
Example of City Feature Classes Migrated to Esri’s LGIM

The LGIM connects silos of information in an organization and integrates processes across typical government departments. It helps provide for more effective operations, better communication, saves time and money and engages citizens in more meaningful ways. In

addition, it also supports data sharing between local governments and regional, state, and federal agencies. Following are the feature datasets defined by the LGIM:

- Address
- Administrative Area
- Assessment Information
- Cadastral Reference
- Capital Planning
- Citizen Service
- Demography
- Election Administration
- Election Results
- Elevation
- Emergency Operations
- Executive Reporting
- Facilities Streets
- Field Crew
- Fire Service Operations
- Infrastructure Operations
- Land Use Operations
- Land Use Planning
- Law Enforcement Operations
- Parcel Editing
- Parcel Publishing
- Public Safety Planning
- Reference Data
- Sewer Stormwater
- Stormwater
- Telemetry
- Water Distribution

The LGIM contains a variety of logically defined feature datasets and feature classes that are common to most local government's spatial data needs. Data that are migrated into the LGIM should be matched as closely as possible to the



Feature Class Mapping to New Schema

representative feature class in the LGIM design (LGIM metadata is useful in making this determination). This is especially important when using the LGIM in conjunction with ArcGIS for Local Government. The LGIM can and should be modified to fit the specific needs of the City of Irvine. Customizations to the LGIM or the Esri Utilities schema (see description below) are acceptable as long as none of the original schema is deleted. An example of this follows using the existing stormwater layer "StormwaterPipe" and showing how this data is mapped to the Esri Water Utilities schema and the use of customizations.

In the above graphic, the example data layer contains both culverts and pipes and the features are separated accordingly into the destination feature classes.

The following shows how the attribute fields would be mapped in this example specific to creating the “swGravityMain” feature class:

Source Attributes	Destination Attributes
UPINVERTDEPTH	UPELEV
UPINVUNRELIABLE	custom
DNINVERTDEPTH	DOWNELEV
DNINVUNRELIABLE	custom
PIPE_SHP	MAINSHAPE
PIPEMATERIAL	MATERIAL
PIPEDIAMETER	DIAMETER
HEIGHT	custom
WIDTH	custom
NUM_PIPES	custom
UPEND_CONDITION	custom
UPEND_INACCESSIBLE	custom
UPEND_COMMENTS	custom
UPEND_STNDRDCOMMENTS	custom
DNEND_CONDITION	custom
DNEND_INACCESSIBLE	custom
DNEND_COMMENTS	custom
DNEND_STNDRDCOMMENTS	custom
MAPDATE	custom
CONSTR_DATE	INSTALLDATE
CONNECTIVITY	custom
INVENTORY_STATUS	custom

In the above table, fields shaded green have a direct match between source attributes and destination attributes in the Water Utilities schema. Fields shaded in gray would be considered custom attributes and would need to be created in the destination schema prior to data migration. This would allow the City to retain all original attributes (if desired) in the new database schema. This same approach can be applied when migrating data to the LGIM.

The LGIM connects silos of information in an organization and integrates processes across typical government departments. It helps provide for more effective operations, better

communication, saves time and money, and engages citizens in more meaningful ways. In addition, it also supports data sharing between local governments and regional, state, and federal agencies.

LGIM Naming Conventions

When custom feature classes and fields are added to the LGIM, the recommended guideline is to add an underscore (_) at the end of the current name. This allows for an easy way to know which layers and fields belong to the LGIM schema and which have been added during the migration. The following are some examples:

- Existing LGIM Feature Class: GeopoliticalArea
- Added Custom Feature Class: Sphere_Of_Influence_
- Existing LGIM Field Name: DISTRICTID
- Added Custom Field Name: UNICORPORATED_AREAS_

LGIM Data Roles and Responsibilities

In developing a GIS data management strategy, it is important to clearly identify data roles and responsibilities. Data roles are important for managing data, including making sure that data are posted correctly and well documented to ensure proper interpretation and to safeguard against misuse or accidental loss. The City should use the following descriptions of different roles and document the division/person fulfilling each of these roles for all GIS data.

The Data Owner is an individual or group within the organization with functional area authority who is responsible for making decisions concerning the use of the datasets. The Data Owner is tasked with the management of spatial datasets. This role is ultimately accountable for the quality of the dataset, including such items as accuracy, timeliness, and completeness. Data Owners understand the business use, issues, and concerns of the datasets they manage. This includes activities such as data conversion, data updating, metadata creation, QA/QC, and data distribution. In any given situation, the Data Owner may delegate any of the responsibilities described above to the Data Steward.

Data Stewards understand the business use, issues, and concerns of the datasets they manage on behalf of the Data Owner. This includes activities such as data conversion, data

updating, metadata creation, QA/QC, and data distribution. The Data Steward's roles and responsibilities are defined per an agreement between the Data Owner and Data Steward and may include any or all of the Data Owner's responsibilities. However, the Data Owner maintains accountability and authority for the decisions and actions relevant to their dataset.

The Data Custodian manages the Enterprise storage and delivery of data provided by Data Owner/Steward. His/her responsibilities include ensuring the security, integrity, and availability of the data.

A Data Stakeholder is any individual or organization, inside or outside of the City, with an interest or share in the use or creation of spatial data.

The LGIM contains datasets that some of the City's data could migrate to, but the data schema is also flexible, allowing additional feature classes, fields, and domains to be added when necessary. The LGIM schema can be viewed here- <https://solutions.arcgis.com/local-government/help/local-government-information-model/get-started/DataDictionary/DataDictionary.htm>. If the City should choose to adopt the LGIM, it is recommended that the City develop a migration plan that identifies where data could fit existing LGIM datasets and where new feature datasets should be created. Alternatively, the LGIM may be used as a reference schema, where suggestions can be made to improve the City's datasets based on layers contained in the LGIM.

Data Management – Metadata

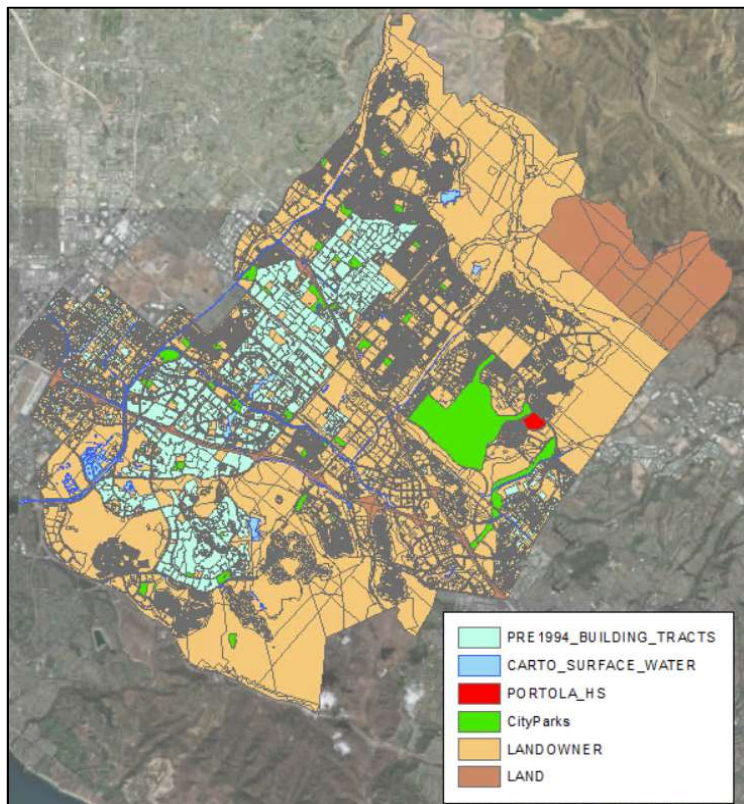
The City maintains metadata for some of the GIS data. However, Irvine needs to fully develop metadata for all GIS data and extend the metadata initiative to non-spatial data (i.e. information about the data within various IT systems). GIS Metadata describes critical information about spatial data's purpose, location, content, and lineage. Geospatial software systems and analysts increasingly rely on metadata to locate, assess, display and manage geospatial data. Metadata support determining suitability for use and may help limit data liability. The metadata is fundamental to the overall quality and usability of the dataset. Without data documentation, GIS data layers can quickly become functionally useless.

Maintaining complete, accurate, and up-to-date GIS metadata is a fundamental GIS best practice. It is recommended that Irvine implement a metadata policy, ensuring the value and appropriateness of Irvine's data repository is documented and preserved. The metadata policy implemented should align with GIS best management practices. The recommended standard is the International Standards Organization (ISO) 19115:2003, US Federal Geographic Data Committee (FGDC) "Content Standard for Digital Geospatial Metadata".

Metadata standards are quite flexible, and the minimum requirements are very simple. However, richer metadata contains detailed and meaningful names, subject keywords, full descriptions, processing, and quality statements that add information and context to the metadata document and support discovery and re-use. Contextual information such as information about the data collection methods and geo-processing helps an analyst determine if the data is appropriate for the current need. Information about access such as terms of use, restrictions on access, or contact information will assist with ensuring the data is used properly.

Esri's ArcGIS software is well-equipped to help Irvine create and maintain metadata. The proposed policy should include metadata procedures utilizing ArcGIS tools. Future reference resources include:

- FGDC Metadata Quick Guide
<http://www.fgdc.gov/metadata/documents/MetadataQuickGuide.pdf>
- FGDC Metadata website
<http://www.fgdc.gov/metadata>
- ISO 19115:2003 Geographic Information Metadata
[http://www.iso.org/iso/catalogue_detail.htm?csnumber=26020\](http://www.iso.org/iso/catalogue_detail.htm?csnumber=26020)



Coinciding Data with Identical Metadata Representing Different Features

About 40% of the Irvine GIS data layers were missing metadata. There is no metadata standard currently in place at the City. There are feature classes that have the same Summary, Description, and items in their metadata; however, they represent different features. For example, the six layers in the figure to the left have coinciding data. These data also have identical metadata summaries and descriptions. It is likely the subsequent five data layers were extracted from LAND. However, their metadata needs to be updated to reflect their individual purposes. At a minimum, the City should complete all metadata

using ArcGIS Item Description metadata style. This style has one page of information, including a Title, Tags, Summary, Description, Credits, and Use Limitations. However, if the City would like to provide more detailed information, they should adopt another metadata style. Other styles carry the information listed previously, as well as sections covering data maintenance or field information listed in different pages of the metadata document. The City should take time and review the metadata styles available and decide which would best fit their organization's needs (<https://pro.arcgis.com/en/pro-app/help/metadata/best->

[practices-for-editing-metadata.htm](#)). After establishing a metadata standard, all feature classes should have their metadata updated and verified using the built-in geoprocessing tools provided by Esri.

Action Item Summary

- ❖ Formally adopt a metadata standard
- ❖ Create, adopt, and enforce a GIS Metadata Policy and SOP
- ❖ Consider extending metadata to key data elements in the various IT systems
- ❖ Hold an annual metadata workshop to train staff on proper metadata creation and maintenance
- ❖ Assign data coordinators responsible for creating and maintaining metadata for each dataset
- ❖ Review metadata once a year to ensure completeness

Data Assessment (Data Management)

As part of this document, a data assessment was conducted on key GIS datasets. A variety of methods were used to include a visual inspection of accuracy and the use of Esri's Data Reviewer software.

Methodical and frequent data review procedures are necessary for the continued health and integrity of GIS data layers. While key digital data layers provided by Irvine were evaluated in this Data Assessment, it is recommended that ongoing data review procedures be implemented and adhered to on a scheduled basis. The ArcGIS Data Reviewer provides an interactive and dynamic environment for these processes to be performed with manual supervision or automatically. It is suggested that this extension is used to improve data quality initially, and then configured to maintain data integrity moving forward. Potential opportunities for leveraging the ArcGIS Data Reviewer include:

- Evaluation of baseline data layer health and integrity
- Automatic detection of feature integrity, attribute completeness, and spatial relationship issues
- Improved visual review for manual data assessments
- Enhanced tracking and communication of data quality
- Automatic report generation and analytics
- Collaborative data quality management processes

Action Item Summary

- ❖ Acquisition and installation of ArcGIS Data Reviewer extension
- ❖ Review and understand the capabilities, methodologies, and strategies of the ArcGIS Data Reviewer
- ❖ Perform and record baseline data assessment(s)
- ❖ Dynamically correct data existing incidents to improve data layer health and integrity
- ❖ Maintain data health and integrity through automated processes and checks
- ❖ Generate reports and analytics as necessary to support ongoing data maintenance workflows and communication

The following are the results of the review of key data layers maintained by the City of Irvine:

Parcels

There are a handful of feature classes with differing coordinate systems or unknown spatial references that should be corrected. The majority of features were projected to NAD_1983_StatePlane_California_VI_ FIPS_0406_Feet. It is recommended to project the others to match. If the City chooses to migrate to LGIM, fields should be reviewed for a possible change of name and creation of new attribution where necessary.

Dataset	Layer	Geometric Accuracy	Attribution
LANDRECORD	DRIVEWAY_LINE	<ul style="list-style-type: none"> • 55 cutbacks • 974 dangles • 17551 duplicate vertex • 197 invalid geometry • 16 multipart • 1575 orphan 	<ul style="list-style-type: none"> • 4 fields • 65408 features • 0 Null or BLANK cells • 0% Null or BLANK
LANDRECORD	LAND	<ul style="list-style-type: none"> • 2227 cutback • 27260 duplicate vertex 	<ul style="list-style-type: none"> • 15 fields • 66129 features • 137175 Null or

Dataset	Layer	Geometric Accuracy	Attribution
		<ul style="list-style-type: none"> • 181 invalid geometry • 598 multipart 	<ul style="list-style-type: none"> • BLANK cells • 13.8% Null or BLANK
LANDRECORD	LANDOWNER	<ul style="list-style-type: none"> • 3229 cutback • 29269 duplicate vertex • 251 invalid geometry • 9547 multipart 	<ul style="list-style-type: none"> • 15 fields • 84429 features • 124470 Null or BLANK cells • 9.8% Null or BLANK
LANDRECORD	LAND_LINE	<ul style="list-style-type: none"> • 23 cutbacks • 4455 dangles • 66801 duplicate vertex • 226 invalid geometry • 35 multipart • 487 orphan 	<ul style="list-style-type: none"> • 11 fields • 308620 features • 42756 Null or BLANK cells • 1.3% Null or BLANK

After a manual review of LAND and LANDOWNER attributes, there are fields that need to be assessed further for accurate content. It is recommended that the fields from the LANDOWNER feature class be renamed or removed. The fields from this feature were derived from an export of joined features (see field names LAND_dis.APN or ASSORTOLAND.Irvine_Parcel for example). The joined field format is “N.f”, where N is the name of the origin table and f is the field name. Fields should be renamed to remove the joined field formatting, which could cause processing errors in the future if this dataset is utilized in extract, transform, load (ETL) processes or data automation tasks.

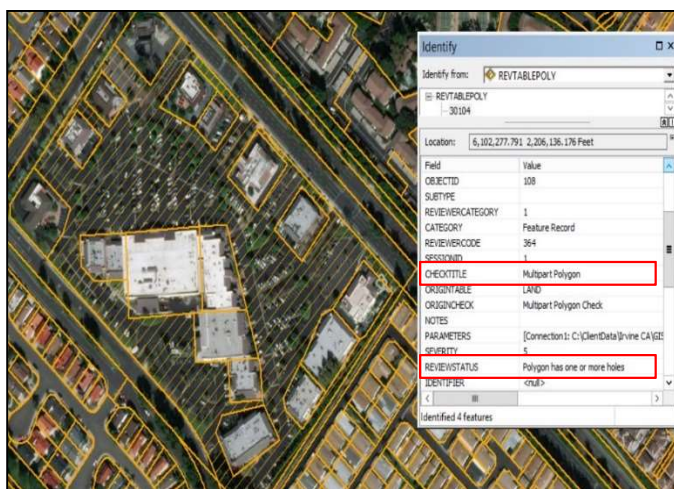


Figure P1-Polygon with Hatch Lines Reported as Multipart Due to "Holes" from Other Polygons Cut Out

Additionally, LANDOWNER carries three fields that reference APN (assessor's parcel number): APN, LAND_dis.APN, and ASSORTOLAND.APN. Field APN contains all Null values, and there is disagreement between LAND_dis.APN and ASSORTOLAND.APN. Verification from the City is needed on which field is accurate. This is an example where fields should be deleted if they are not accurate or being utilized. A table, ASSORTOLAND, exists in the database

that carries some attributes found in LANDOWNER. A relate should be made between the table and feature class. This would allow users access to information without creating additional fields and would simplify updating fields. The unique ID field that links the table and feature class need clarification from the City.

The features with invalid geometry will need to be repaired and then reviewed again to ensure those anomalies were resolved. 576 out of the 598 multipart anomalies occur from features having other features cut out from them (figure P1). These cutouts are reported as “holes.” These instances are acceptable and do not require further review. The remaining 22 multipart polygons should be reviewed and simplified where appropriate. The duplicate vertex anomalies are common, with 27260 instances in LAND and 29269 instances in LANDOWNER. These could have resulted from digitizing errors or from loading data into a feature class that had a different horizontal resolution specified.

Upon visual inspection, an additional geometric check, Polygon Sliver, was run on LAND and LANDOWNER. Slivers are small, unwanted polygons that usually result from intersecting layers that are not congruent. Their presence is usually an inaccurate representation of the data and can increase processing time. For the check that was performed

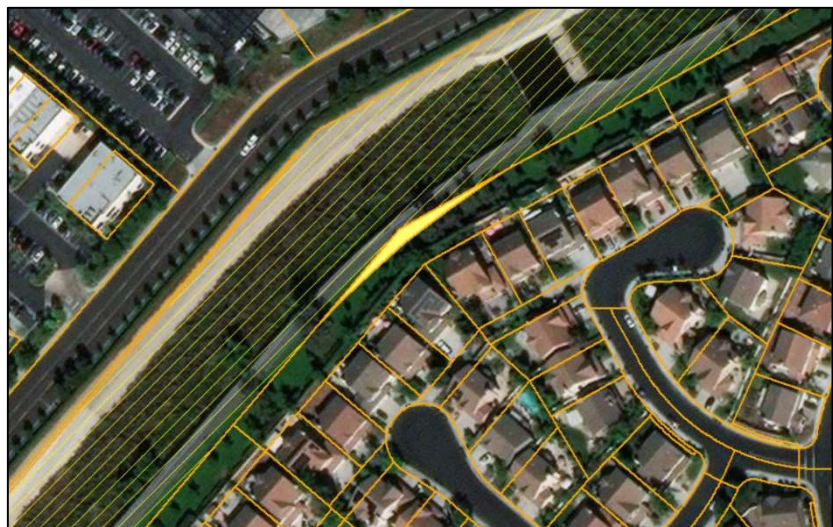


Figure P2- Example Sliver in LAND Feature Class

on the City's data, slivers had to be less than 200 square meters (0.05 acres) to be considered, and have a thinness ratio of 0.5. A thinness ratio of 1 would find very thick polygons like a circle, while a ratio of 0 would find thinner polygons. 4251 slivers were found within LAND and 2337 were found in LANDOWNER. Some of these represented sidewalks or medians between divided highways, however, there were anomalies that should be reviewed and corrected. *Figure P2* shows a sliver in solid yellow that had a description of “Channel,” similar to the hatched polygon adjacent to it. In this example, it is recommended to merge these two features together.

Another example (figure P3) found in LAND and LANDOWNER feature classes shows a sliver with a description of "Open Space." All surrounding polygons also have this description. With no physical feature in the imagery to distinguish



Figure P3-Example of Sliver in LAND and LANDOWNER Feature Classes for "Open Space" Polygon Features

it, it is recommended to also merge this sliver with another feature. The resulting feature dataset of the Polygon Sliver check can be supplied to the City on request.

The City's parcel data could benefit from further organization. This could be facilitated during migration to the LGIM if desired. Migration to the LGIM would resolve the previously mentioned field name anomalies and clearly define the purpose of each feature class. The City should consider reviewing the parcel data for slivers that could be dissolved into surrounding features and for invalid geometries that need repairing. Additionally, the City should enable editor tracking before the review and editing process to maintain organization, accountability, and reliable up-to-date data.

Street Centerlines

The City's street centerline data is represented by the feature classes IRVINE_CENTERLINE, NEWLINE, and intersections are represented by IRVINECL_PT, all located in the CENTERLINE feature dataset.

Dataset	Layer	Geometric Accuracy	Attribution
CENTERLINE	IRVINECL_PT	<ul style="list-style-type: none"> • 50 duplicate geometry 	<ul style="list-style-type: none"> • 3 fields • 8452 features • 0 Null or BLANK cells • 0% Null or BLANK

Dataset	Layer	Geometric Accuracy	Attribution
CENTERLINE	IRVINE_CENTERLINE	<ul style="list-style-type: none"> • 1 cutbacks • 1851 duplicate vertex • 1 orphan 	<ul style="list-style-type: none"> • 24 fields • 10321 features • 58129 Null or BLANK cells • 23.5% Null or BLANK
CENTERLINE	NEWLINE	<ul style="list-style-type: none"> • 2 dangles • 2 duplicate vertex 	<ul style="list-style-type: none"> • 19 fields • 97 features • 1358 Null or BLANK cells • 73.7% Null or BLANK



Figure CL1-Two Sections of NEWLINE Street Centerline Features Shown in Teal, Overlaid Imagery

NEWLINE had the most attribution anomalies, where over 70% of fields were null or blank. According to the 'Irvine Centerline Update Procedure' and 'irvinecl_lc' documents provided by the City, NEWLINE contains features that will be added to the IRVINE_CENTERLINE feature class. When overlaying NEWLINE on 2016 imagery (Esri), the areas are either under development or have not experienced change yet (figure CL1). It is recommended to add the features from NEWLINE to the IRVINE_CENTERLINE feature once attribution is populated and track the status of the roads' constructions via an attribute field.

It is recommended for the City to migrate the feature classes IRVINE_CENTERLINE and IRVINECL_PT to the LGIM feature classes Street and StreetIntersection, respectively. IRVINE_CENTERLINE carries additional attributes compared to the LGIM feature class, Street. These fields could be added to the LGIM schema as custom fields. Migrating IRVINECL_PT to the LGIM would require adding fields, as the current feature class does not carry any

attribute describing the cross streets. This could be calculated using the street centerline feature.

Address Points

The City’s address points are represented by the feature class BLDG_XY. According to the ‘Address Points’ document provided by the City, BLDG_XY is generated from the BLDGADDRESS table and the building footprint feature class, BUILDING. BLDG_XY has extensive coverage of the City (figure 8) and its attributes are well populated where less than 30% of fields are Null or blank. These fields describe street prefixes and suffixes or are street directions, which may have no associated value. The City should standardize how to represent features with no applicable value for these fields, either leaving them with a Null value or as blank.

Dataset	Layer	Geometric Accuracy	Attribution
	BLDG_XY	<ul style="list-style-type: none"> • 67723 duplicate geometry 	<ul style="list-style-type: none"> • 21 fields • 126328 features • 583243 Null or BLANK cells • 22% Null or BLANK

Originally, the Duplicate Geometry check was run on BLDG_XY, a point feature class, and resulted in no anomalies. The first run specifically looked for features with coincident locations and identical attribution. A second Duplicate Geometry check was run where attributes did not have to be identical for overlapping points. This run resulted in 67723 incidents (reflected in the table above). Multi-unit complexes that are represented by a single building footprint in the BUILDING feature class have coinciding points (figure AP1). The City should discuss if they require higher accuracy address points, where their location better reflects the unit's midpoint.

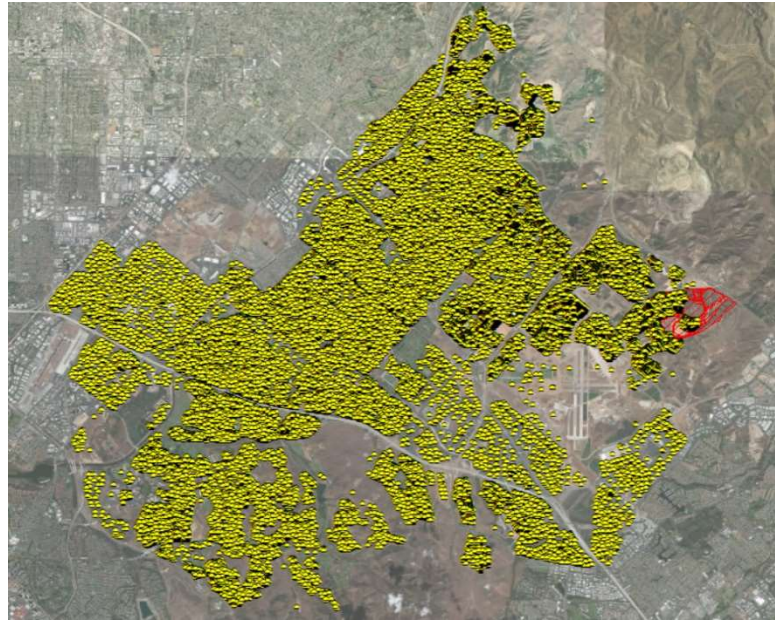


Figure AP1. BLDG_XY Feature Class Shown in Yellow, ADDRESSING_LINE and ADDRESSING_POLY Shown in Red

Additionally, the ADDRESS field currently carries many numeric values. However, 975 features have alpha values, the pound ('#') sign preceding the number, or descriptions such as 'Accessory,' 'Demolished,' 'N/A,' and others that would be better carried in a comments field. Some of the alpha values represent addresses for garages, laundry facilities, and maintenance buildings, using 'G', 'L', and 'M' to denote these, respectively. An attribution standard operating procedure should also be developed for this layer to improve its application for public safety and routing purposes.

Should the City choose to migrate to the LGIM, BLDG_XY could migrate to the feature class SiteAddressPoint within the Address feature dataset. This feature class carries many useful fields, many of which the existing fields in BLDG_XY could be mapped to (<https://solutions.arcgis.com/local-government/help/local-government-information-model/get-started/DataDictionary/DataDictionary.htm#FeatureClassSiteAddressPoint>). For example, the Mun field in BLDG_XY would be mapped to the MUNICIPALITY field in SiteAddressPoint. Some fields will require additional support before being mapped. For example, a combination of the NAME, PREFIX, and SUFFIX fields in BLDG_XY would be mapped to populate

the FULLNAME field in SiteAddressPoint. Another option for the City would be to create a standard schema with attribution standards to follow. For example, schema could carry a field UnitType, which designates what type of structure the building is. This field could point to a domain that restricts the values it takes,

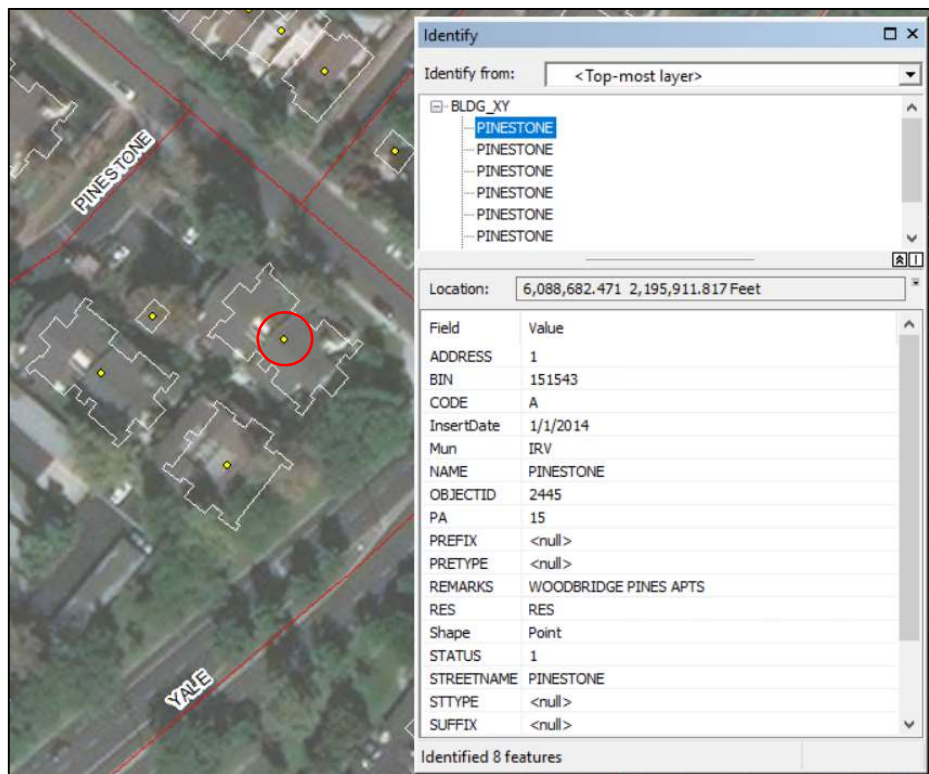


Figure AP2. Coinciding address points for a multi-unit building.

such as 'Apt', 'House', 'Duplex', or 'Maintenance'. Currently, no domains are used in BLDG_XY. Developing a new standard schema, attribution standard operating procedures, and domains would be more time intensive compared to adopting and migrating to the LGIM schema.

The City should consider migrating to the LGIM, which would standardize the data on a uniform data structure, place the BLDG_XY feature class into a dataset, and create domains for fields with repetitive inputs. The City should review current domains and make recommendations where existing domains can be utilized in BLDG_XY. Migrating to the LGIM would also enable the City to leverage ArcGIS Solutions and Manage Address Information.

This is a collection of maps and databases used to manage the core layers of road centerlines, site addresses, facilities, and mailing addresses, and also aggregate this information from authoritative sources for use by state and regional agencies. (See <https://solutions.arcgis.com/local-government/land-records/manage-addresses/>). This Solution supplies a configured Data Reviewer batch job file that would simplify the data assessment task. The City should also enable editor tracking on all of these features to maintain organized and accurate data.

Other Key Data Layers

Adding to the above-mentioned data layers, the City has a collection of other layers that were reviewed. The following section will cover the Great Park data layers and the iSHUTTLE, CONFLICT_OF_INTEREST, and IUSD datasets. The City has many more layers within its database that are not covered in detail here. It is recommended that the City complete a full data assessment on all data in the future.

The Great Park

The Great Park is an ongoing project that City has been developing since 2013 (figure GP1). Spatially, the project will encompass over 1000 acres. As a whole, this is an important project that requires a thoughtful and detailed approach and management to ensure its success. The City has over 50 feature classes relating to the



Figure GP1. The Orange County Great Park Plan

Great Park. A large majority of these feature classes are not within a feature dataset, have inconsistent and nondescript naming, and have varying extents (figure GP2). If the City does not need the feature classes to cover areas outside of the Great Park's boundary, the feature classes should be clipped to the appropriate extent. Carrying a more concise extent will improve processing times and simplify map navigation. These feature classes should be reviewed for necessity, have their metadata populated, and moved into a feature dataset.

Most Great Park feature classes follow the naming convention of beginning with 'GP' (noted in the previous 'Database-wide Suggestions' section). This could be used to begin grouping the feature classes into a feature dataset.

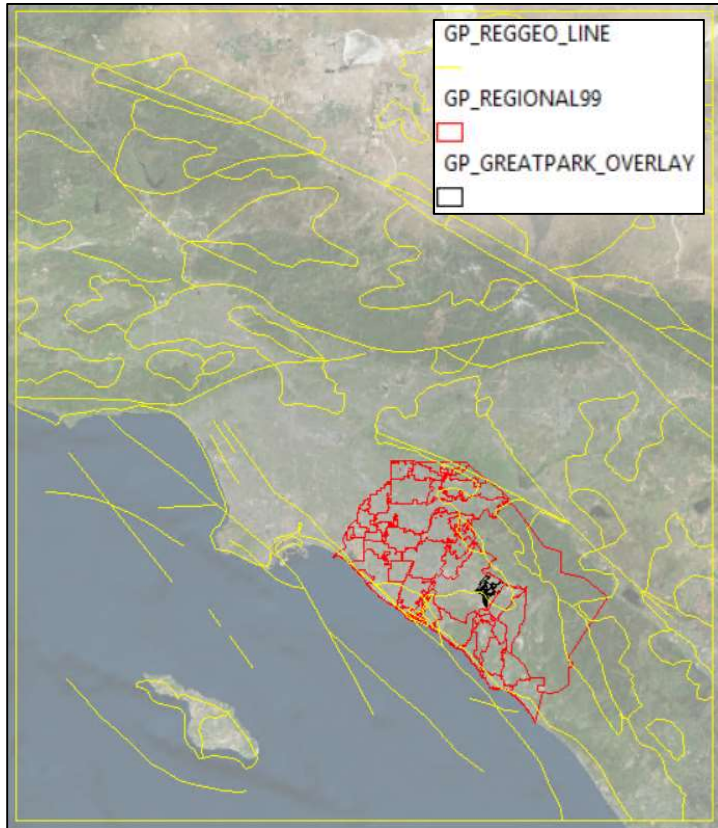


Figure GP2. Varying Extents of Feature Classes Related to the Great Park Project

If the City chooses to migrate to the LGIM, the feature dataset could be a custom feature dataset within the geodatabase. The custom feature dataset should have a standard operating procedure developed for populating attribution and maintaining the feature classes' accuracy. Currently, there is minimal attribution associated with most feature classes. 12 out of 49 feature classes only carried the required OBJECTID and Shape fields. Others carry additional fields, but most are populated with Null or blank values. Domains are utilized for some of these feature classes.

If the City chooses to migrate to the LGIM, there are feature classes that could be used as references for building a standard schema for the Great Park features. The Great Park is a unique entity. It would be more logical and provide more flexibility if a custom feature dataset was created, compared to migrating to an existing LGIM feature class. The LGIM feature classes ParkRecreationFacility and ParkRecreationSite could serve as example standard data schemas for the City's reference. It is recommended that the City develop a custom feature dataset and standard operating procedure for attribution and domains for the Great Park dataset.

iSHUTTLE

The iSHUTTLE feature dataset has 8 feature classes, 4 point feature classes representing bus stops, and 4 line feature classes representing route lines (figure IS1). There is overlap between 2 feature classes at most (overlapping routes and stops) (figure13). Each line feature class contains one feature, and all carry the same fields. It is recommended to append these feature classes into one to improve organization and efficiency. The point features should also be appended into a single point feature class. Unique IDs based on route number(s) could be generated for each line segment/point.

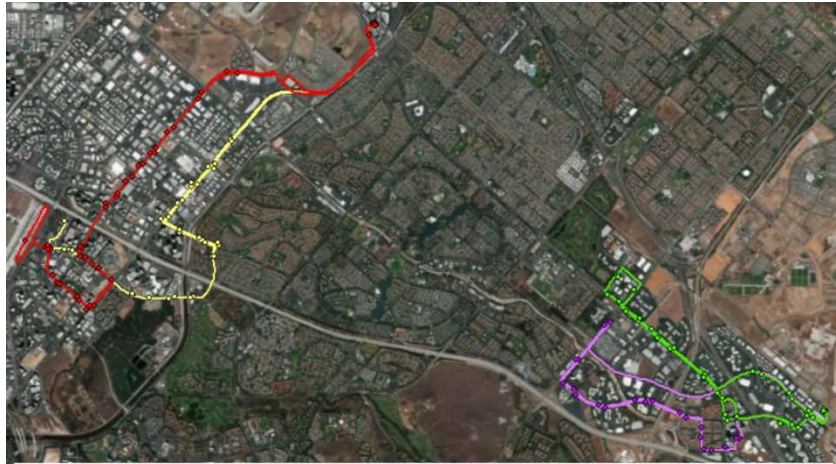


Figure IS1. iSHUTTLE Dataset with 8 Features

Should the City choose to migrate to the LGIM, the point feature classes could be appended to the LGIM feature class TransportationFacility within the ReferenceData feature dataset. Currently, the LGIM does not contain a polyline feature class that represents bus routes. Therefore, a custom feature class could be created for the iSHUTTLE routes.

IUSD

The IUSD dataset contains feature classes of school boundaries and school districts. There are multiple boundary feature classes representing different information (e.g. attendance), and some boundaries are not in agreement (e.g. IUSD_BOUNDARY_POLY vs. IUSD_BOUNDARY_LINE, see *figure IUSD1*). It is recommended that the City develop metadata for each layer specifying their purpose. The City should also enable editor tracking to ensure data is representing current boundaries and information.

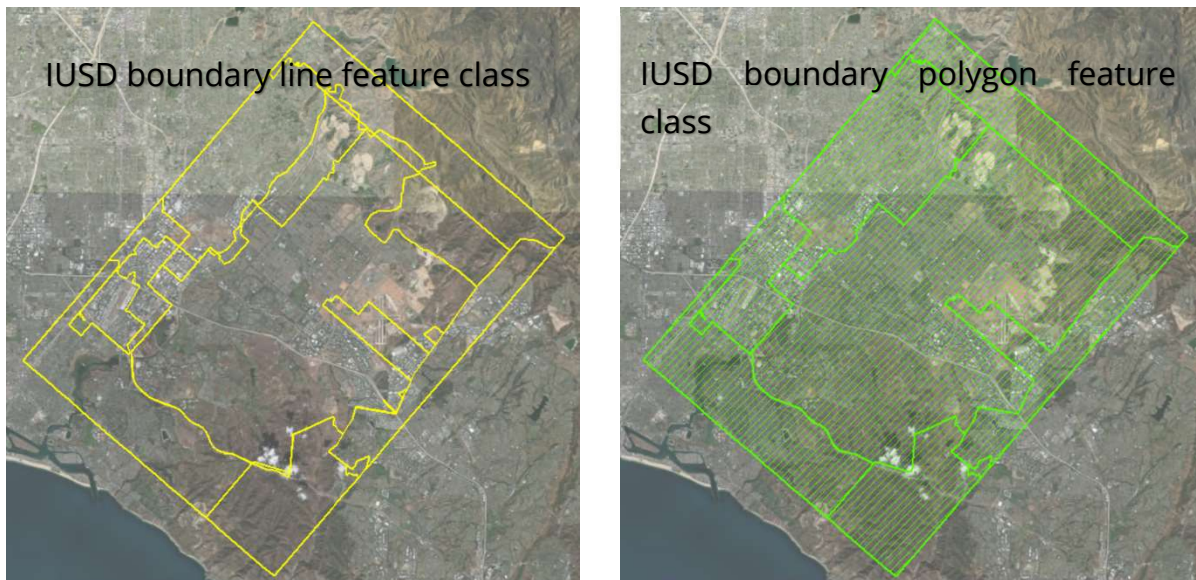


Figure IUSD1. Boundary Discrepancies Between IUSD_BOUNDARY_LINE and IUSD_BOUNDARY_POLY

Should the City choose to employ the LGIM, these feature classes would be a good example of how the LGIM can help make data more succinct and organized. Each polygon boundary feature class could migrate to the existing LGIM feature class, EducationSite, while the point feature class IUSD_SCHOOL_PT feature class could migrate to the EducationalFacility feature class, all housed within the ReferenceData feature dataset.

Overview of Recommendations

The following recommendations would improve the organization of the City's data, as well as promote data accuracy and reliability:

Action Item Summary

- ❖ Adopt and migrate to Esri's ArcGIS LGIM or use the LGIM as a reference schema
 - Migrate to existing LGIM feature classes where possible, create custom feature classes when necessary
 - The LGIM can offer guidance for developing an informative and organized database schema
- ❖ Enable editor tracking on all data
- ❖ Formally adopt a metadata standard, and generate and maintain metadata for all data
- ❖ Perform a visual review of LAND and LANDOWNER feature classes for spatial accuracy and address the presence of slivers
- ❖ Review layers with unknown or differing spatial reference from NAD_1983_StatePlane_California_VI_FIPS_0406_Feet (see MDL for list) and either project or re-project
- ❖ Complete and append NEWLINE to IRVINE_CENTERLINE
- ❖ Reorganize the feature classes associated with the Great Park project into a feature dataset
 - Review each feature class for potential cleanup of attributes and extent
- ❖ Determine how other thematically similar feature classes could be reorganized into feature datasets
- ❖ Append the iSHUTTLE line feature classes to a target layer, append the iSHUTTLE point feature classes to a target layer
- ❖ Review and clean up the IUSD feature dataset
 - Remove deprecated and redundant feature classes while ensuring remaining data is up-to-date

Appendix A - Master Data List

This appendix can be used as a preliminary Master Data List (MDL) for the City. Maintaining an MDL improves enterprise organization and communication between data users in the City. This MDL documents the dataset the data layer is contained in, data layer name, type, description, spatial reference, the assigned steward or department, and the quality check frequency. This information was compiled using the data within the geodatabase provided by the City and the data needs identified throughout this project.

Legend

The following describes the suggested grouping of the data layers identified in the needs assessment and summarized in the MDL table:

Data Layer	This column identifies the data layer by name. The data layer is the GIS thematic data that is being described. The name of the layer or description of the layer is placed in this column.
Creation Methodology	This column describes how the layer was, or is, anticipated being created.
Recommended Update Division or Individual	This field outlines the division or individual that is anticipated to maintain or develop the data layer during and after full implementation of the City-wide enterprise GIS. Development of new recommended layers will be prioritized for each year of the Strategic Implementation Plan.
Layer Status	Layer state of existence defined as follows:
Existing	These layers currently exist within the City's GIS.
Recommended	These layers are recommended for development or procurement, based on departmental and enterprise needs. These data layers will help support existing business procedures or will compliment other GIS data sets that are already existing and in use by the City. Costs associated for these recommended layers will be based on general estimates - actual cost may vary.
Partial	These layers currently exist in an incomplete or outdated state

Recommended Grouping	This field outlines logical grouping of layers “features” into different feature datasets within the Enterprise Database. These groupings are based on the data structure defined by Esri’s Local Government Information Model (LGIM) . A system like this should be used for the Published Enterprise Database.
Address	This dataset contains point address features such as the site address and other feature classes required for the administration of address information.
Cadastral Reference	This dataset contains a series of features used to describe the cadastral reference system (PLSS, Control, etc.).
Demography	This dataset contains a collection of features used to report information about human geography including census blocks and tracts.
Electoral Districts	This dataset contains territorial subdivisions for electing members to a legislative body along with precinct and polling places.
Elevation	This dataset contains a collection of features that describe the physical terrain including spot elevations and elevation contours.
Facilities Streets	Various facilities associated with streets including streets, buildings, curbs, ramps, guard rails, poles, trees, etc.
Fire Service Operations	Collection of features used by fire service professionals to preserve life, property, and promote public safety.
Infrastructure Operations	This dataset contains a collection of features used to capture public infrastructure operations information.
Land Use Planning	This dataset contains a collection of features used to inventory land use patterns including flood zones, current and proposed land uses, and zoning.
Law Enforcement Operations	This dataset contains a collection of features used by law enforcement professionals to protect life, property, and promote public safety.
Parcel Editing	This dataset contains a series of features used to manage land records information. Subs, condos, lots, tax parcels, and encumbrances are managed in a parcel fabric.
Parcel Publishing	Published parcel data including tax parcels, encumbrances, and blocks.
Raster Data	External to the LGIM and stored in a separate geodatabase. Raster imagery such as aerial photography, satellite imagery and LiDAR, and GIS grids and surfaces.
Public Safety Planning	Data including emergency facility locations, special events, and historic damage assessments.
Reference Data	This dataset contains a collection of features that provide geographic context in a community including building footprints, street centerlines, soils, vegetation, and water bodies.
Custom FD	Custom Feature Dataset that is not included with the standard LGIM data model. Necessary to support data not normally found in the LGIM.

Recommended Update Frequency	This Column provides a recommended minimum of how often these data layers should be updated. In order to have an accurate and up to date GIS, layers must be updated on a set schedule. This is provided as a guideline on updating the listed data layers.
Daily	These layers should be updated on a Daily basis; mostly these are automated layers from other databases or applications.
Weekly	These layers are recommended to be updated or checked for updates on a Weekly basis.
Monthly	These layers are recommended to be updated or checked for updates on a Monthly basis.
Quarterly	These layers are recommended to be updated or checked for updates on a Quarterly basis.
Yearly	These layers are recommended to be updated or checked for updates on a Yearly basis. All layers that are not updated within a year should be checked for updated or updated at least once a year.
As Needed	These layers are updated based on an As Needed basis. Many of these layers maybe updated daily or weekly. Many of these layers are high use layers.
Automated	This layer will be mined out of an existing database.

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
3D Park Layers	Contracted collection	Community Services	Recommended	Raster Data	As Needed
3D Stadium and Buildings	Contracted collection	Great Park (Public Works/Community Services)	Existing	Raster Data	As Needed
Access Points to Restoration Projects	Digitize from aerial imagery and other sources	Information Technology/GIS staff	Recommended	Reference Data	As Needed
Accessory Dwelling Units	Digitize, CAD data	Community Development	Recommended	Reference Data	Quarterly
Address Points	Automated creation using building footprints and address table, run nightly	Information Technology/GIS staff	Partial	Address	Daily
Aerial Photography	Contracted collection	Information Technology/GIS staff	Existing	Raster Data	Yearly
Airport	Digitize	Information Technology/GIS staff	Existing	Reference Data	Yearly
Amphitheater	Digitize, field collection	Great Park (Public Works/Community Services)	Existing	Custom FD	Yearly
Animal Control Cases	Geocode	Public Safety (CAD,Police,EOC)	Recommended	Custom FD	Weekly
APNs (for Great Park)	Digitizing from imagery, CAD, ASSORTOLAND table for APNs	Information Technology/GIS staff	Partial	Custom FD	Daily
Asset and Facility Inventory (for Great Park)	Digitizing from imagery, CAD	Great Park (Public Works/Community Services)	Partial	Custom FD	Quarterly
Best Management Practices	Digitize, various sources	Information Technology/GIS staff	Existing	Custom FD	Yearly
Bike Shops	Digitize	Transportation	Recommended	Reference Data	Yearly
Bike/Pedestrian Counts	Geocode	Transportation	Partial	Custom FD	Monthly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Biotic Resources	Various sources	Information Technology/GIS staff	Existing	Custom FD	Yearly
Building buffer	Buffer in ArcMap	Information Technology/GIS staff	Existing	Reference Data	As Needed
Building Outlines/Footprints	CAD	Information Technology/GIS staff	Existing	Reference Data	Yearly
Bus Stops and Amenities	Digitize	Transportation	Existing	Custom FD	As Needed
Business License (pending, approved, denied)	Extracted from table, match to address	Community Development	Existing	Reference Data	Daily
Cameras	CCTV	Information Technology/GIS staff	Existing	Facility Streets	Automated
Cannabis labs	Digitizing and buffer tool	Community Development	Recommended	Reference Data	Yearly
Census Demographic	Census	Public Safety (CAD,Police,EOC) and Information Technology/GIS staff	Recommended	Demography	Yearly
Chameleon DB data	Chameleon database	Community Services	Recommended	Custom FD	As Needed
CIP (Public Works)	Digitize, various sources	Public Works	Existing	Land Use Planning	Monthly
City Boundary	Digitize from various source	Information Technology/GIS staff	Existing	Custom FD	Yearly
City Boundary Buffer	Buffer in ArcMap	Information Technology/GIS staff	Existing	Custom FD	Yearly
City Property Leases	OnBase database, auto update using APN	Finance and Information Technology/GIS staff	Recommended	Reference Data	Monthly
City-owned Property	OnBase database, auto update using APN	Information Technology/GIS staff	Existing	Reference Data	Monthly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Cleveland National Forest	Digitize from aerial imagery	Great Park (Public Works/Community Services)	Recommended	Reference Data	Yearly
Commissioners	Digitize	Information Technology/GIS staff	Existing	Electoral Districts	Yearly
Community Crime Map	TBD	Public Safety (CAD,Police,EOC)	Recommended	Custom FD	Weekly
Community Facilities District/Assessment Districts	Extract from parcel data from county	Finance and Information Technology/GIS staff	Existing	Land Use Planning	Yearly
Community Facility Districts	Digitize	Information Technology/GIS staff	Existing	Custom FD	Yearly
Congressional Districts	Extract from CA State Senate sources	Information Technology/GIS staff	Existing	Electoral Districts	Yearly
Contaminants in Great Park	Geocode records from various source	Community Development	Existing	Custom FD	Monthly
Contour lines	Extract from elevation data	Information Technology/GIS staff	Existing	Elevation	Yearly
Contour lines (for Great Park)	Extract from elevation data	Great Park (Public Works/Community Services) and Information Technology/GIS staff	Existing	Elevation	Yearly
Creeks	Digitize, extract from USGS	Information Technology/GIS staff	Existing	Reference Data	Yearly
Current Projects	Digitize from various source	Information Technology/GIS staff	Existing	Land Use Planning	Monthly
Dam Inundation	Digitize, extract using various sources and elevation data	Information Technology/GIS staff	Existing	Public Safety Planning	Yearly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Damage Assessment	Digitize, field collection, various sources	Public Safety (CAD,Police,EOC), Information Technology/GIS staff	Existing	Public Safety Planning	Monthly
Demolished buildings	Manual attribution, digitize	Information Technology/GIS staff	Existing	Reference Data	Monthly
Development Districts	Digitize, extract from parcels	Information Technology/GIS staff	Existing	Land Use Planning	Monthly
Downtown Apartment Communities	CAD	Public Safety (CAD,Police,EOC)	Recommended	Reference Data	Yearly
Driveways	Digitize	Information Technology/GIS staff	Existing	Custom FD	As Needed
Easements (Public Works)	CAD	Public Works and Information Technology/GIS staff	Partial	Parcel Publishing	Yearly
Electric	Digitize from various utility records	Public Safety (CAD,Police,EOC)	Recommended	Reference Data	Quarterly
Electric Vehicle Charging Station	Field collection, digitize, geocode records	Transportation	Recommended	Custom FD	Monthly
Environment	Digitize, various sources	Information Technology/GIS staff	Existing	Land Use Planning	Yearly
Environmental Hazards	Digitize, extract from elevation data, land cover	Public Safety (CAD,Police,EOC), Information Technology/GIS Staff	Existing	Fire Service Operations	Yearly
EOC	Digitize	Information Technology/GIS staff	Existing	Reference Data	Yearly
EV Structures	Field collection, digitize, geocode records	Public Works	Recommended	Custom FD	Yearly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Facility Maintenance Assets	Geocode records from various source	Public Works	Recommended	Reference Data	As Needed
Facility Maintenance Assets (for Great Park)	Geocode records from various source	Great Park (Public Works/Community Services)	Partial	Custom FD	As Needed
Fault lines	Extract from various sources, digitize geologic records	Information Technology/GIS staff	Existing	Reference Data	Yearly
Fiber Optic	Digitize, field collection	Information Technology/GIS staff	Existing	Custom FD	Monthly
Fire	Digitize, various sources	Public Safety (CAD,Police,EOC), Information Technology/GIS Staff	Existing	Fire Service Operations	Yearly
Fire Access	Digitize	Great Park (Public Works/Community Services)	Recommended	Custom FD	Quarterly
Fire Stations	Digitize	Public Safety (CAD,Police,EOC), Information Technology/GIS staff	Existing	Public Safety Planning	Yearly
Firm zones	FEMA	Finance and Information Technology/GIS staff	Existing	Public Safety Planning	Yearly
Fixed Assets	Extracted from various resources	Finance and Information Technology/GIS staff	Recommended	Parcel Publishing	Quarterly
Freeways	Digitize	Information Technology/GIS staff	Existing	Reference Data	As Needed
Future streets and improvements	CAD, digitize	Transportation	Recommended	Reference Data	As Needed
Gated Communities	Digitize, extract from parcels	Information Technology/GIS staff	Existing	Land Use Planning	Yearly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Great Park Sections	Digitize	Great Park (Public Works/Community Services)	Existing	Custom FD	Yearly
Green Cover	Digitize from aerial imagery and other sources	Public Works	Existing	Facility Streets	Yearly
Hazard Mitigation Plan	TBD	Public Safety (CAD,Police,EOC)	Recommended	Fire Service Operations	Quarterly
Historical sites	Digitize	Information Technology/GIS staff	Existing	Reference Data	Yearly
HOA boundaries	Digitize, extract from parcel data	Information Technology/GIS staff	Existing	Electoral Districts	Quarterly
HOA Conflict of Interest	Digitize, extract from parcel data	Information Technology/GIS staff	Existing	Custom FD	Yearly
HOA/Commissioner Buffers	Buffer in ArcMap	Information Technology/GIS staff	Existing	Custom FD	Yearly
Incident Management	Recorded from various source	Transportation	Recommended	Custom FD	As Needed
Indoor LiDAR Great Park Facilities	Contracted collection	Community Services	Recommended	Raster Data	Yearly
Infrastructure	Digitized, CAD	Public Works	Recommended	Reference Data	Yearly
Infrastructure Assessment of Great Park	Field collection, geocode records	Great Park (Public Works/Community Services)	Recommended	Custom FD	Yearly
Irvine Business Complex	Digitize	Finance and Information Technology/GIS staff	Existing	Reference Data	Quarterly
Irvine Ranch Water District	Digitize, extract from parcels	Public Safety (CAD,Police,EOC)	Recommended	Reference Data	Yearly
Jails	Digitize	Public Safety (CAD,Police,EOC), Information Technology/GIS Staff	Existing	Custom FD	Yearly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Jurisdictional Boundaries	Extract from parcel data from county	Public Safety (CAD,Police,EOC)	Existing	Electoral Districts	Yearly
Landscaping	Field collection	Public Works	Existing	Facility Streets	Quarterly
Landscaping (for Great Park)	Field collection	Great Park (Public Works/Community Services)	Recommended	Custom FD	Quarterly
Landslide Potential	Digitize, various sources	Public Safety (CAD,Police,EOC), Information Technology/GIS Staff	Existing	Public Safety Planning	Yearly
Large Festivals	Geocode records from various source, digitize areas using aerial imagery and various sources	Community Services	Recommended	Custom FD	Yearly
Location Great Park Users (CivicRec)	CivicRec database	Great Park (Public Works/Community Services)	Recommended	Custom FD	Automated
Location of Special Needs Residents (Route Match)	TBD	Community Services	Recommended	Public Safety Planning	As Needed
Lucity Work Orders	Lucity database	Great Park (Public Works/Community Services)	Recommended	Custom FD	As Needed
Lucity Work Orders (for Great Park)	Lucity database	Public Works	Recommended	Custom FD	As Needed
Medians	Extracted from LAND data, using centerline and parcel data	Transportation	Recommended	Fire Service Operations	As Needed
Memorial Park Benched	Digitized, field collection	Community Services	Recommended	Reference Data	Yearly
Meters/Electrical Meters	Field collection, digitize existing data records	Finance and Information Technology/GIS staff	Recommended	Custom FD	Monthly
Monuments	Digitized, field collection	Community Services	Existing	Reference Data	Yearly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
New Street Centerlines	Digitize, field collection	Information Technology/GIS staff	Existing	Reference Data	As Needed
OnBase	OnBase database	Public Works	Recommended	Custom FD	Automated
Open Space	Digitize from aerial imagery and other sources	Information Technology/GIS staff	Partial	Reference Data	Yearly
Paleontological sites	Digitize	Information Technology/GIS staff	Existing	Reference Data	Yearly
Parcel liens, value, owners, and more	Parcel data from county	Information Technology/GIS staff	Existing	Parcel Publishing	Yearly
Parcels	Parcel data from county	Information Technology/GIS staff	Existing	Parcel Publishing	Yearly
Park Boundaries	Digitize from aerial imagery and other sources	Information Technology/GIS staff	Partial	Reference Data	Yearly
Park Customers	TBD	Community Services	Recommended	Custom FD	Monthly
Park Infrastructure	Digitize from aerial imagery, extract from building footprints	Community Services	Recommended	Reference Data	Quarterly
Park Ownership (HOA or City owned)	Extracted from tables, OnBase database, auto update using APN	Information Technology/GIS staff	Existing	Reference Data	Daily
Parking	Digitize	Great Park (Public Works/Community Services)	Existing	Custom FD	Quarterly
Parking Variance	Various sources	Public Safety (CAD,Police,EOC)	Existing	Custom FD	As Needed
Parks	Digitize	Public Works	Partial	Reference Data	Yearly
Pavement	Digitize, extract from imagery	Transportation	Recommended	Facility Streets	Quarterly
Pest Management	Field collection	Public Works	Recommended	Custom FD	Monthly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Peter's Canyon	Digitize	Public Works	Recommended	Reference Data	Yearly
Planning Area Tract Boundaries	Field collection, extract from parcel data, digitize from imagery	Community Development	Existing	Land Use Planning	Monthly
Police station	Digitize	Public Safety (CAD,Police,EOC), Information Technology/GIS staff	Existing	Public Safety Planning	Yearly
pre-PLANS	TBD	Public Safety (CAD,Police,EOC)	Recommended	Custom FD	Quarterly
Property Boundaries	Parcel data from county	Information Technology/GIS staff	Existing	Parcel Publishing	Yearly
Public vs. Private Streets	Manual attribution to centerline data	Information Technology/GIS staff	Existing	Facility Streets	As Needed
Quadrants for Code Enforcement Cases	Digitize and extract boundaries from parcel data	Community Development	Recommended	Custom FD	Yearly
Railroads	Digitize	Transportation	Existing	Reference Data	Yearly
Regional Geology	USGS	Information Technology/GIS staff	Existing	Reference Data	Yearly
Regulatory Layers	Digitize and extract boundaries from parcel data	Community Services	Recommended	Custom FD	Quarterly
Restoration Projects	Digitize from aerial imagery and other sources	Information Technology/GIS staff	Recommended	Land Use Planning	Quarterly
Restrooms on Trails	Digitize, field collection	Transportation	Recommended	Reference Data	Yearly
Ridership Counts	Geocode records from various source	Transportation	Recommended	Custom FD	Monthly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Ridge line	Digitize, extract from elevation data	Information Technology/GIS staff	Existing	Reference Data	Yearly
Road closures	Digitized, various sources	Transportation	Existing	Custom FD	As Needed
Road Way Lane Deployment	Extracted from centerline data	Information Technology/GIS staff	Partial	Facility Streets	As Needed
Roadway Moratoriums	TBD	Transportation	Recommended	Custom FD	As Needed
School attendance	Various sources	Information Technology/GIS staff	Existing	Custom FD	Yearly
School Districts	Digitize and manual attribution	Information Technology/GIS staff	Existing	Custom FD	Yearly
Schools	Digitize	Information Technology/GIS staff	Existing	Custom FD	Yearly
Sensitive species	Digitize, various sources	Information Technology/GIS staff	Existing	Custom FD	Yearly
Sidewalks	Extract from parcel data from county, digitize	Information Technology/GIS staff	Partial	Facility Streets	As Needed
Signal Modification	Digitize, geocode records	Transportation	Recommended	Custom FD	As Needed
Signals and Boxes	Digitize, geocode records	Public Works	Existing	Custom FD	Monthly
Signs (Public works)	Digitize, geocode records	Public Works	Existing	Custom FD	Monthly
Slope	Extract from elevation data	Information Technology/GIS staff	Existing	Reference Data	Yearly
Sniper Viewshed	Create in ArcMap (viewshed tool)	Public Safety (CAD, Police, EOC)	Recommended	Custom FD	As Needed
Soils	Extract from NRCS Soil Survey	Information Technology/GIS staff	Existing	Reference Data	Yearly
Solar Feasibility	TBD	Public Works	Recommended	Reference Data	Quarterly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Solid Waste Facilities/Recycling Stations	Digitize existing records	Information Technology/GIS staff	Partial	Reference Data	Yearly
Sphere of Influence	Various sources	Information Technology/GIS staff	Existing	Custom FD	Yearly
Sports Facilities	Digitize	Great Park (Public Works/Community Services) and Information Technology/GIS staff	Existing	Reference Data	Yearly
Storm Drainage	Digitize, field collection	Public Works	Recommended	Custom FD	Yearly
Street Centerlines	Digitize, field collection, append new features to existing layer	Information Technology/GIS staff	Existing	Reference Data	As Needed
Street Improvement Plans	Digitized	Transportation	Existing	Custom FD	Monthly
Street Intersections	Extracted from centerline data	Information Technology/GIS staff	Existing	Facility Streets	As Needed
Streets (for Great Park)	Digitize, field collection, append new features to existing layer	Great Park (Public Works/Community Services) and Information Technology/GIS staff	Partial	Custom FD	As Needed
TomTom data	Contracted collection	Transportation	Existing	Custom FD	Yearly
Traffic Accident and Incidents	Geocode records, various source	Transportation	Recommended	Custom FD	Automated
Traffic Flow Pattern/Volume	Various sources	Public Safety (CAD,Police,EOC)	Recommended	Custom FD	Automated
Traffic Management and Control (Signs, signals)	Digitize, field collection	Public Works	Partial	Custom FD	Monthly

Data Layer	Creation Methodology	Recommended Update Division or Individual	Existing or Recommended?	Recommended Data Grouping (Feature Dataset)	Recommended Update Frequency
Trail information	Digitize	Great Park (Public Works/Community Services) and Information Technology/GIS staff	Existing	Reference Data	Yearly
Transit Routes	Digitize	Information Technology/GIS staff	Existing	Custom FD	Yearly
Underground Infrastructure	Digitize, import from existing sources, georeference	Public Safety (CAD,Police,EOC)	Recommended	Custom FD	Yearly
Utility layers	Digitize, import from existing sources, georeference	Finance and Information Technology/GIS staff	Recommended	Custom FD	Monthly
Water	Digitize	Information Technology/GIS staff	Existing	Reference Data	Yearly
Water Quality	Various sources	Information Technology/GIS staff	Existing	Custom FD	Quarterly
Watersheds	Extract from USGS, extract from elevation data	Information Technology/GIS staff	Existing	Reference Data	Yearly
WAZE	Various sources	Public Safety (CAD,Police,EOC)	Recommended	Custom FD	Automated
What is inside/outside of City Limits	Intersect in ArcMap	Community Services	Recommended	Custom FD	Yearly
Wildlife Corridor	Digitize from aerial imagery	Information Technology/GIS staff	Existing	Reference Data	Yearly
Zoning	Digitized	Information Technology/GIS staff	Existing	Land Planning Use	Monthly

Appendix B – Data Assessment Table

This table contains summarized results from the Data Reviewer and Attribution check.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
CENTERLINE	IRVINECL_PT	<ul style="list-style-type: none"> • 50 duplicate geometry 	<ul style="list-style-type: none"> • 3 fields • 8452 features • 0 Null or BLANK cells • 0% Null or BLANK 	Benefit from more detailed attribution.	Medium	Transition to a standard data schema.
CENTERLINE	IRVINE_CENTER LINE	<ul style="list-style-type: none"> • 1 cutbacks • 1851 duplicate vertex • 1 orphan 	<ul style="list-style-type: none"> • 24 fields • 10321 features • 58129 Null or BLANK cells • 23.5% Null or BLANK 	Benefit from more detailed attribution.	Medium	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
CENTERLINE	NEWLINE	<ul style="list-style-type: none"> • 2 dangles • 2 duplicate vertex 	<ul style="list-style-type: none"> • 19 fields • 97 features • 1358 Null or BLANK cells • 73.7% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
CONFLICT_OF_INTEREST	com_hoa	<ul style="list-style-type: none"> • 24 cutback vertex • 12 invalid geometry • 37 multipart 	<ul style="list-style-type: none"> • 13 fields • 89 features • 149 Null or BLANK cells • 12.9% Null or BLANK 		Low	Transition to a standard data schema.
CONFLICT_OF_INTEREST	com_hoa_500_buffer	No incidents	<ul style="list-style-type: none"> • 15 fields • 77 features • 216 Null or BLANK cells • 18.7% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
CONFLICT_OF_INTEREST	comm500buffer	No incidents	<ul style="list-style-type: none"> • 13 fields • 95 features • 179 Null or BLANK cells • 14.5% Null or BLANK 		Low	Transition to a standard data schema.
CONFLICT_OF_INTEREST	commissioners	<ul style="list-style-type: none"> • 1 cutback • 48 duplicate vertex • 2 multipart 	<ul style="list-style-type: none"> • 11 fields • 95 features • 80 Null or BLANK cells • 7.7% Null or BLANK 		Low	Transition to a standard data schema.
iSHUTTLE	Route_400_Route_2	<ul style="list-style-type: none"> • 1 cutbacks • 1 duplicate vertex • 1multipart • 1 orphan 	<ul style="list-style-type: none"> • 7 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 	High rates of disconnection (>50%)	Medium	Heads-up digitizing, and potential on-site verification, to improve geometric accuracy. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
iSHUTTLE	Route_400_Stops_2	No incidents	<ul style="list-style-type: none"> • 7 fields • 46 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
iSHUTTLE	Route_401_Route_2	<ul style="list-style-type: none"> • 1 cutbacks • 1 duplicate vertex • 1 multipart • 1 orphan 	<ul style="list-style-type: none"> • 7 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 	High rates of disconnection (>50%)	Medium	Heads-up digitizing, and potential on-site verification, to improve geometric accuracy. Transition to a standard data schema.
iSHUTTLE	Route_401_Stops_2	No incidents	<ul style="list-style-type: none"> • 7 fields • 48 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
iSHUTTLE	Route_402_Route_2	<ul style="list-style-type: none"> • 1 duplicate vertex • 1 multipart • 1 orphan 	<ul style="list-style-type: none"> • 7 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 	High rates of disconnection (>50%)	Medium	Heads-up digitizing, and potential on-site verification, to improve geometric accuracy. Transition to a standard data schema.
iSHUTTLE	Route_402_Stops_2	No incidents	<ul style="list-style-type: none"> • 7 fields • 34 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
iSHUTTLE	Route_403_Route_2	<ul style="list-style-type: none"> • 1 duplicate vertex • 1 multipart • 1 orphan 	<ul style="list-style-type: none"> • 7 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 	High rates of disconnection (>50%)	High	Repair geometry after review. Heads-up digitizing, and potential on-site verification, to improve geometric accuracy.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						Transition to a standard data schema.
iSHUTTLE	Route_403_Stops_2	No incidents	<ul style="list-style-type: none"> • 7 fields • 37 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
IUSD	COMFACDIST_NEW	<ul style="list-style-type: none"> • 41 cutback • 37 duplicate vertex • 11 multipart 	<ul style="list-style-type: none"> • 18 fields • 78 features • 750 Null or BLANK cells • 53.4% Null or BLANK 	Missing significant attribution	High	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
IUSD	IUSD_ATTENDANCE	<ul style="list-style-type: none"> • 36 cutback vertex • 57 duplicate vertex • 14 invalid geometry 	<ul style="list-style-type: none"> • 12 fields • 66 features • 132 Null or BLANK cells • 16.7% Null or BLANK 		Low	Transition to a standard data schema.
IUSD	IUSD_ATTENDANCE_2019	<ul style="list-style-type: none"> • 7 cutback vertex • 12 duplicate vertex • 8 multipart 	<ul style="list-style-type: none"> • 10 fields • 43 features • 6 Null or BLANK cells • 1.4% Null or BLANK 		Low	Transition to a standard data schema.
IUSD	IUSD_ATTENDANCE_ELEMENT_INTERIM	<ul style="list-style-type: none"> • 4 cutback vertex • 23 duplicate vertex • 4 invalid geometry 	<ul style="list-style-type: none"> • 11 fields • 35 features • 5 Null or BLANK cells • 1.3% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
IUSD	IUSD_BOUNDARY_LINE	<ul style="list-style-type: none"> • 3 cutbacks vertex • 57 duplicate vertex • 8 invalid geometry • 1 multipart 	<ul style="list-style-type: none"> • 4 fields • 211 features • 211 Null or BLANK cells • 25% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
IUSD	IUSD_BOUNDARY_POLY	<ul style="list-style-type: none"> • 3 cutback • 8 duplicate vertex • 4 invalid geometry 	<ul style="list-style-type: none"> • 8 fields • 8 features • 8 Null or BLANK cells • 12.5% Null or BLANK 		Low	Transition to a standard data schema.
IUSD	IUSD_COMFACDIST	<ul style="list-style-type: none"> • 4 cutback • 14 duplicate vertex • 1 invalid geometry • 7 multipart 	<ul style="list-style-type: none"> • 8 fields • 37 features • 54 Null or BLANK cells • 18.2% Null or BLANK 		Low	Transition to a standard data schema.
IUSD	IUSD_GRIDCODE	<ul style="list-style-type: none"> • 9 cutback • 25 duplicate vertex • 1 invalid geometry 	<ul style="list-style-type: none"> • 8 fields • 66 features • 79 Null or BLANK cells • 15% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
IUSD	IUSD_SCHOOL_PT	No incidents	<ul style="list-style-type: none"> • 11 fields • 48 features • 25 Null or BLANK cells • 4.7% Null or BLANK 		Low	Transition to a standard data schema.
LANDRECORD	DRIVEWAY_LINE	<ul style="list-style-type: none"> • 55 cutbacks • 974 dangles • 17551 duplicate vertex • 197 invalid geometry • 16 multipart • 1575 orphan 	<ul style="list-style-type: none"> • 4 fields • 65408 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
LANDRECORD	LAND	<ul style="list-style-type: none"> • 2227 cutback • 27260 duplicate vertex • 181 invalid geometry • 598 multipart 	<ul style="list-style-type: none"> • 15 fields • 66129 features • 137175 Null or BLANK cells • 13.8% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
LANDRECORD	LANDOWNER	<ul style="list-style-type: none"> • 3229 cutback • 29269 duplicate vertex • 251 invalid geometry • 9547 multipart 	<ul style="list-style-type: none"> • 15 fields • 84429 features • 124470 Null or BLANK cells • 9.8% Null or BLANK 		Low	Transition to a standard data schema.
LANDRECORD	LAND_LINE	<ul style="list-style-type: none"> • 23 cutbacks • 4455 dangles • 66801 duplicate vertex • 226 invalid geometry • 35multipart • 487 orphan 	<ul style="list-style-type: none"> • 11 fields • 308620 features • 42756 Null or BLANK cells • 1.3% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	AMPHITHEATRE_TEMP	No incidents	<ul style="list-style-type: none"> • 6 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	CONTOUR_10FT	No incidents	<ul style="list-style-type: none"> • 7 fields • 18634 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
PA51_OCGP	COUNTY_ADDR ESS_GRID	No incidents	<ul style="list-style-type: none"> • 6 fields • 2470 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	CREEKS	No incidents	<ul style="list-style-type: none"> • 22 fields • 17 features • 8 Null or BLANK cells • 2.1% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	DEV_DISTRICTS	No incidents	<ul style="list-style-type: none"> • 6 fields • 9 features • 5 Null or BLANK cells • 9.3% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	FIRESTATION_2 0	No incidents	<ul style="list-style-type: none"> • 6 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	GP_AMPHI_RO ADS	No incidents	<ul style="list-style-type: none"> • 5 fields • 8 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
PA51_OCGP	GP_SECTIONS	No incidents	<ul style="list-style-type: none"> • 6 fields • 9 features • 2 Null or BLANK cells • 3.7% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	GP_STREETS	No incidents	<ul style="list-style-type: none"> • 13 fields • 6237 features • 6237 Null or BLANK cells • 7.7% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	PORTOLA_HS	No incidents	<ul style="list-style-type: none"> • 5 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
PA51_OCGP	SIGNAGE	No incidents	<ul style="list-style-type: none"> • 10 fields • 225 features • 47 Null or BLANK cells • 2.1% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
PA51_OCGP	SPORTS_FAC	No incidents	<ul style="list-style-type: none"> • 8 fields • 80 features • 1 Null or BLANK cells • 0.2% Null or BLANK 		Low	Transition to a standard data schema.
PA51_OCGP	WATERSHED	No incidents	<ul style="list-style-type: none"> • 11 fields • 3 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
Every item from this point forward are layers that are not in a dataset.	ADDRESSGRID_LINE	No incidents	<ul style="list-style-type: none"> • 4 fields • 2470 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADDRESSING_LINE	<ul style="list-style-type: none"> • 2 cutbacks • 8 duplicate vertex • 4 invalid geometry 	<ul style="list-style-type: none"> • 11 fields • 206 features • 406 Null or BLANK cells • 17.9% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ADDRESSING_P OLY	<ul style="list-style-type: none"> • 1 cutback • 7 duplicate vertex • 1 multipart 	<ul style="list-style-type: none"> • 15 fields • 44 features • 176 Null or BLANK cells • 26.7% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_ARTERI AL_CENTERLINE	<ul style="list-style-type: none"> • 1 cutbacks • 15 dangles • 56 duplicate vertex • 24 invalid geometry • 8multipart • 2 orphan 	<ul style="list-style-type: none"> • 5 fields • 506 features • 48 Null or BLANK cells • 1.9% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_ASSESS MENT_DISTRICT	<ul style="list-style-type: none"> • 10 cutback • 16 duplicate vertex • 5 multipart 	<ul style="list-style-type: none"> • 7 fields • 27 features • 33 Null or BLANK cells • 17.5% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ADMIN_BAKE_F EE_DIST_RESO_ 90_84	<ul style="list-style-type: none"> • 2 cutback • 7 duplicate vertex 	<ul style="list-style-type: none"> • 5 fields • 10 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_CENSU S2000	No incidents	<ul style="list-style-type: none"> • 9 fields • 1417 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_CENSU S2010	<ul style="list-style-type: none"> • 220 cutback • 611 duplicate vertex • 86 multipart 	<ul style="list-style-type: none"> • 35 fields • 2629 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_CHILDC ARE_CENTER_P T	No incidents	<ul style="list-style-type: none"> • 9 fields • 82 features • 246 Null or BLANK cells • 33.3% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						standard data schema.
	ADMIN_CITY_BOUNDARY	No incidents	<ul style="list-style-type: none"> • 5 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_CITY_BOUNDARY_Copy	<ul style="list-style-type: none"> • 1 duplicate vertex 	<ul style="list-style-type: none"> • 5 fields • 2 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_CITYO_WNED_PROPERTIES	<ul style="list-style-type: none"> • 947 cutback • 1307 duplicate vertex • 50 invalid 	<ul style="list-style-type: none"> • 20 fields • 2210 features • 17508 Null or BLANK cells • 39.6% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		geometry • 21 multipart				null values via research or on-site collection. Transition to a standard data schema.
	ADMIN_CONGR SSIONAL_DIST RICT	• 44 cutback • 35 duplicate vertex • 4 multipart	• 6 fields • 53 features • 0 Null or BLANK cells • 0% Null or BLANK		Low	Transition to a standard data schema.
	ADMIN_CONGR SSIONAL_DIST RICT_2012	• 51 cutback • 52 duplicate vertex • 4 multipart	• 11 fields • 53 features • 96 Null or BLANK cells • 16.5% Null or BLANK		Low	Transition to a standard data schema.
	ADMIN_DRAIN GRID	No incidents	• 5 fields • 399 features • 183 Null or BLANK cells • 9.2% Null or BLANK		Medium	Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ADMIN_EDENG RID	No incidents	<ul style="list-style-type: none"> • 5 fields • 3432 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_EDENG RIDLINE	No incidents	<ul style="list-style-type: none"> • 3 fields • 3432 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_FACI	No incidents	<ul style="list-style-type: none"> • 10 fields • 91 features • 409 Null or BLANK cells • 44.9% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						collection. Transition to a standard data schema.
	ADMIN_FREEWAYS	<ul style="list-style-type: none"> • 1 dangles • 8 duplicate vertex 	<ul style="list-style-type: none"> • 25 fields • 250 features • 1102 Null or BLANK cells • 17.6% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	ADMIN_GATED_COMMUNITY	<ul style="list-style-type: none"> • 10 cutback vertex • 62 duplicate vertex • 2 invalid geometry • 5 multipart 	<ul style="list-style-type: none"> • 5 fields • 81 features • 14 Null or BLANK cells • 3.5% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_GRIDLINE	No incidents	<ul style="list-style-type: none"> • 11 fields • 1457 features • 7437 Null or BLANK cells • 46.4% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						collection. Transition to a standard data schema.
	ADMIN_GRIDLINE_POLY	No incidents	<ul style="list-style-type: none"> • 6 fields • 702 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_HOMEOWNER_ASSOCIATION	<ul style="list-style-type: none"> • 68 cutback vertex • 303 duplicate • 5 invalid geometry • 118 multipart 	<ul style="list-style-type: none"> • 14 fields • 382 features • 1217 Null or BLANK cells • 22.8% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_IBC_FEE_DIST	<ul style="list-style-type: none"> • 2 duplicate vertex 	<ul style="list-style-type: none"> • 6 fields • 2 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	ADMIN_IBC_SIDEWALK	No incidents	<ul style="list-style-type: none"> • 6 fields • 545 features 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
			<ul style="list-style-type: none"> • 0 Null or BLANK cells • 0% Null or BLANK 			
	ADMIN_IBC_SID EWALKS_CURBS	<ul style="list-style-type: none"> • 4 cutbacks • 203 dangles • 1223 duplicate vertex • 4 invalid geometry • 3 multipart • 77 orphan 	<ul style="list-style-type: none"> • 13 fields • 9568 features • 20379 Null or BLANK cells • 16.4% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	ADMIN_IRVINE_SPHERE	<ul style="list-style-type: none"> • 1 cutbacks • 1 duplicate vertex 	<ul style="list-style-type: none"> • 4 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	ADMIN_IRVINE_SPHERE_LINE	<ul style="list-style-type: none"> • 1 cutbacks • 1 dangles • 5 duplicate vertex • 1 multipart 	<ul style="list-style-type: none"> • 4 fields • 15 features • 11 Null or BLANK cells • 18.3% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ADMIN_ITAM3 B	<ul style="list-style-type: none"> • 50 cutback • 126 duplicate vertex • 7 invalid geometry • 2 multipart 	<ul style="list-style-type: none"> • 5 fields • 967 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_JAIL_S TE_PT	No incidents	<ul style="list-style-type: none"> • 6 fields • 60 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_OCTAM 3_3TAZ	<ul style="list-style-type: none"> • 536 cutback • 630 duplicate vertex • 28 invalid geometry • 2 multipart 	<ul style="list-style-type: none"> • 9 fields • 3142 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_OLD_F ORTUNE	<ul style="list-style-type: none"> • 22 duplicate vertex • 2 invalid geometry 	<ul style="list-style-type: none"> • 11 fields • 35 features • 16 Null or BLANK cells • 4.2% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ADMIN_OUTER TAZ	<ul style="list-style-type: none"> • 7 cutback 	<ul style="list-style-type: none"> • 5 fields • 63 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_OUTSIDE_CITY_LINE	<ul style="list-style-type: none"> • 19 cutbacks • 110 dangles • 1287 duplicate vertex • 33 invalid geometry • 6 orphan 	<ul style="list-style-type: none"> • 11 fields • 4640 features • 11338 Null or BLANK cells • 22.2% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_OUTSIDE_CITY_POLY	<ul style="list-style-type: none"> • 26 cutback • 650 duplicate vertex • 5 multipart 	<ul style="list-style-type: none"> • 14 fields • 912 features • 4550 Null or BLANK cells • 35.6% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						collection. Transition to a standard data schema.
	ADMIN_PLANNING_FEE	<ul style="list-style-type: none"> • 6 cutback • 26 duplicate vertex • 3 multipart 	<ul style="list-style-type: none"> • 7 fields • 48 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_RAILROAD_LINE	<ul style="list-style-type: none"> • 6 duplicate vertex 	<ul style="list-style-type: none"> • 4 fields • 20 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_STATE_ASSEMBLY_DISTRICT	<ul style="list-style-type: none"> • 69 cutback • 39 duplicate vertex • 3 multipart 	<ul style="list-style-type: none"> • 6 fields • 80 features • 73 Null or BLANK cells • 15.2% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_STATE_	<ul style="list-style-type: none"> • 77 cutback • 78 duplicate 	<ul style="list-style-type: none"> • 10 fields • 80 features • 155 Null or BLANK 		Medium	Repair geometry after review. Transition to a

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ASSEMBLY_DIST RICT_2012	vertex • 3 multipart	cells • 19.4% Null or BLANK			standard data schema.
	ADMIN_STATE_ SENATE_DISTRI CT	• 38 cutback • 25 duplicate vertex • 3 multipart	• 7 fields • 40 features • 34 Null or BLANK cells • 12.1% Null or BLANK		Low	Transition to a standard data schema.
	ADMIN_STATE_ SENATE_DISTRI CT_2012	• 38 cutback • 40 duplicate vertex • 3 multipart	• 10 fields • 40 features • 74 Null or BLANK cells • 18.5% Null or BLANK		Low	Transition to a standard data schema.
	ADMIN_SUBDIV ISION_LINE	• 1 duplicate vertex	• 3 fields • 541 features • 0 Null or BLANK cells • 0% Null or BLANK		Low	Transition to a standard data schema.
	ADMIN_TRANS _CORRIDOR_LI NE	• 1 cutbacks • 2 duplicate vertex • 1multipart • 1 orphan	• 4 fields • 5 features • 0 Null or BLANK cells • 0% Null or BLANK		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ADMIN_TRANSI T_ROUTE_LINES	<ul style="list-style-type: none"> • 4 cutbacks • 1 dangles • 74 duplicate vertex • 2 invalid geometry • 74 multipart 	<ul style="list-style-type: none"> • 6 fields • 77 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_TRANS PORTATION_FEE	<ul style="list-style-type: none"> • 1 duplicate vertex 	<ul style="list-style-type: none"> • 5 fields • 4 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ADMIN_TRANS PORTATION_FEE E_COUNTY	<ul style="list-style-type: none"> • 4 cutback • 5 duplicate vertex • 1 multipart 	<ul style="list-style-type: none"> • 15 fields • 6 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	ADMIN_UNI_TE CH_FIRESTN_6_ FEE	No incidents	<ul style="list-style-type: none"> • 5 fields • 3 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ADMIN_ZIPCODE	<ul style="list-style-type: none"> • 1106 cutback • 4 duplicate vertex • 26 multipart 	<ul style="list-style-type: none"> • 8 fields • 2026 features • 4 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	BLDG_XY	No incidents	<ul style="list-style-type: none"> • 21 fields • 126328 features • 583243 Null or BLANK cells • 22% Null or BLANK 	Benefit from more detailed attribution.	High	Repair geometry after review. Transition to a standard data schema.
	BLDG_XY_WBU FFER	No incidents	<ul style="list-style-type: none"> • 25 fields • 139244 features • 1233340 Null or BLANK cells • 35.4% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	BldgXYEden	No incidents	<ul style="list-style-type: none"> • 24 fields • 129169 features • 750641 Null or BLANK cells • 24.2% Null or BLANK 		Low	Transition to a standard data schema.
	BUILDING	<ul style="list-style-type: none"> • 208 cutback • 37074 duplicate vertex • 161 invalid geometry • 231 multipart 	<ul style="list-style-type: none"> • 23 fields • 65421 features • 562944 Null or BLANK cells • 37.4% Null or BLANK 	Missing significant attribution	High	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	BUILDING_1000 ft_buffer	No incidents	<ul style="list-style-type: none"> • 22 fields • 12916 features • 93770 Null or BLANK cells • 33% Null or BLANK 	Missing significant attribution	High	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Repair geometry after review. Transition to a standard data schema.
	BUILDING_WBU FFER	<ul style="list-style-type: none"> • 208 cutback • 37074 duplicate vertex • 161 invalid geometry • 231 multipart 	<ul style="list-style-type: none"> • 25 fields • 78337 features • 907695 Null or BLANK cells • 46.3% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						standard data schema.
	BUILDINGS_DEMOLISHED	<ul style="list-style-type: none"> • 6 cutback • 927 duplicate vertex • 3 invalid geometry • 11 multipart 	<ul style="list-style-type: none"> • 21 fields • 1232 features • 10679 Null or BLANK cells • 41.3% Null or BLANK 	Missing significant attribution	High	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Repair geometry after review. Transition to a standard data schema.
	CARTO_CITYFREEWAY	<ul style="list-style-type: none"> • 3 duplicate vertex • 2 multipart • 1 orphan 	<ul style="list-style-type: none"> • 7 fields • 7 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	CARTO_COUNTYFREEWAY	<ul style="list-style-type: none"> • 1 cutbacks • 1 dangles • 7 duplicate 	<ul style="list-style-type: none"> • 7 fields • 14 features • 1 Null or BLANK cells • 1% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		<ul style="list-style-type: none"> vertex • 8 multipart 				
	CARTO_SURFACE_WATER	<ul style="list-style-type: none"> • 26 cutback • 29 duplicate vertex • 12 invalid geometry • 14 multipart 	<ul style="list-style-type: none"> • 13 fields • 449 features • 1115 Null or BLANK cells • 19.1% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	CD_Office_Locator	<ul style="list-style-type: none"> • 81 dangles • 679 duplicate vertex • 9 invalid geometry • 5 multipart • 38 orphan 	<ul style="list-style-type: none"> • 5 fields • 1391 features • 52 Null or BLANK cells • 0.7% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	CD_Office_Staff	No incidents	<ul style="list-style-type: none"> • 8 fields • 253 features • 332 Null or BLANK cells • 16.4% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	CIPLine	<ul style="list-style-type: none"> • 5 cutbacks • 3 duplicate vertex • 1 invalid geometry • 9 orphan 	<ul style="list-style-type: none"> • 10 fields • 9 features • 10 Null or BLANK cells • 11.1% Null or BLANK 	High rates of disconnection (>50%)	High	Repair geometry after review. Heads-up digitizing, and potential on-site verification, to improve geometric accuracy. Transition to a standard data schema.
	CIPPoint	No incidents	<ul style="list-style-type: none"> • 9 fields • 6 features • 2 Null or BLANK cells • 3.7% Null or BLANK 		Low	Transition to a standard data schema.
	CIPPolygon	<ul style="list-style-type: none"> • 2 cutback • 4 duplicate vertex • 1 multipart 	<ul style="list-style-type: none"> • 11 fields • 12 features • 15 Null or BLANK cells • 11.4% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	CITY_BIKEWAY	<ul style="list-style-type: none"> • 2 cutbacks • 19 dangles • 15 duplicate vertex • 1 invalid geometry • 4 multipart • 34 orphan 	<ul style="list-style-type: none"> • 8 fields • 539 features • 158 Null or BLANK cells • 3.7% Null or BLANK 		Low	Transition to a standard data schema.
	CityFiberOptic	<ul style="list-style-type: none"> • 22 dangles • 373 duplicate vertex • 3 invalid geometry • 373 multipart • 27 orphan 	<ul style="list-style-type: none"> • 11 fields • 821 features • 448 Null or BLANK cells • 5% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	CityParks	<ul style="list-style-type: none"> • 8 cutback • 41 duplicate vertex • 5 multipart 	<ul style="list-style-type: none"> • 42 fields • 61 features • 385 Null or BLANK cells • 15% Null or BLANK 		Low	Transition to a standard data schema.
	DAC_PROJECTS	<ul style="list-style-type: none"> • 12 cutback • 263 duplicate 	<ul style="list-style-type: none"> • 11 fields • 921 features 		Medium	Repair geometry after review.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		<ul style="list-style-type: none"> vertex • 5 invalid geometry • 75 multipart 	<ul style="list-style-type: none"> • 1840 Null or BLANK cells • 18.2% Null or BLANK 			Transition to a standard data schema.
	EMER_DA_ARE A	<ul style="list-style-type: none"> • 4 cutback • 7 duplicate vertex 	<ul style="list-style-type: none"> • 9 fields • 62 features • 1 Null or BLANK cells • 0.2% Null or BLANK 		Low	Transition to a standard data schema.
	EMER_DA_WS	No incidents	<ul style="list-style-type: none"> • 5 fields • 17 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	EMER_DAGRID	No incidents	<ul style="list-style-type: none"> • 9 fields • 325 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	EMER_DAM_IN NUNDATION_LI NE	<ul style="list-style-type: none"> • 10 cutbacks • 1 dangles • 27 duplicate vertex • 1 invalid 	<ul style="list-style-type: none"> • 4 fields • 374 features • 342 Null or BLANK cells • 22.9% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		geometry • 11 orphan				
	EMER_DAM_IN UNDATION	• 38 cutback • 25 duplicate vertex • 7 multipart	• 5 fields • 111 features • 0 Null or BLANK cells • 0% Null or BLANK		Low	Transition to a standard data schema.
	EMER_FACILITY	• 24 cutback • 37 duplicate vertex • 1 invalid geometry • 1 multipart	• 4 fields • 200 features • 0 Null or BLANK cells • 0% Null or BLANK		Low	Transition to a standard data schema.
	EMER_FACILITY _PT	No incidents	• 4 fields • 212 features • 0 Null or BLANK cells • 0% Null or BLANK		Low	Transition to a standard data schema.
	EMER_GEOPOLI CE	• 12 cutback • 1 duplicate vertex • 4 multipart	• 9 fields • 287 features • 4 Null or BLANK cells • 0.2% Null or BLANK		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	EMER_IDEC	No incidents	<ul style="list-style-type: none"> • 7 fields • 5 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_BASEFLOOD_LINE	<ul style="list-style-type: none"> • 172 orphan 	<ul style="list-style-type: none"> • 4 fields • 172 features • 0 Null or BLANK cells • 0% Null or BLANK 	High rates of disconnection (>50%)	Medium	Heads-up digitizing, and potential on-site verification, to improve geometric accuracy. Transition to a standard data schema.
	ENV_BASIN	<ul style="list-style-type: none"> • 8 cutback 	<ul style="list-style-type: none"> • 4 fields • 75 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_BMP	<ul style="list-style-type: none"> • 8 cutback • 1 duplicate vertex • 3 multipart 	<ul style="list-style-type: none"> • 9 fields • 155 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ENV_CATCHBAS IN_PT	No incidents	<ul style="list-style-type: none"> • 5 fields • 2188 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_CITYTIN_LI NE	<ul style="list-style-type: none"> • 380 cutbacks • 5 dangles • 1378 duplicate vertex • 8 invalid geometry • 4038 orphan 	<ul style="list-style-type: none"> • 9 fields • 21359 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_CLIMATE_ ZONE_LINE	No incidents	<ul style="list-style-type: none"> • 3 fields • 13 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_ELEVATIO N_CONTOUR_LI NE	<ul style="list-style-type: none"> • 46 cutbacks • 10 duplicate vertex • 10 multipart • 325 orphan 	<ul style="list-style-type: none"> • 4 fields • 515 features • 0 Null or BLANK cells • 0% Null or BLANK 	High rates of disconnection (>50%)	High	Repair geometry after review. Heads-up digitizing, and potential on-site verification, to improve geometric

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						accuracy. Transition to a standard data schema.
	ENV_ELTORO_C ONTOUR	<ul style="list-style-type: none"> • 3 invalid geometry 	<ul style="list-style-type: none"> • 35 fields • 89536 features • 268608 Null or BLANK cells • 8.6% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	ENV_FACILITY	No incidents	<ul style="list-style-type: none"> • 12 fields • 97 features • 595 Null or BLANK cells • 51.1% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ENV_FAULT_LINE	<ul style="list-style-type: none"> • 2 duplicate vertex • 13 orphan 	<ul style="list-style-type: none"> • 4 fields • 284 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_FHSZ_11_2011	<ul style="list-style-type: none"> • 26 cutback vertex • 346 duplicate • 19 multipart 	<ul style="list-style-type: none"> • 8 fields • 366 features • 168 Null or BLANK cells • 5.7% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_FIRE	<ul style="list-style-type: none"> • 3 cutback vertex • 3 duplicate • 1 multipart 	<ul style="list-style-type: none"> • 5 fields • 6 features • 1 Null or BLANK cells • 3.3% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_FIRE_ORDINANCE_ZONE	<ul style="list-style-type: none"> • 32 cutback vertex • 311 duplicate • 4 invalid geometry • 13 multipart 	<ul style="list-style-type: none"> • 6 fields • 472 features • 245 Null or BLANK cells • 8.7% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_FIREHAZARD	<ul style="list-style-type: none"> • 3 cutback vertex • 4 duplicate 	<ul style="list-style-type: none"> • 8 fields • 16 features 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		<ul style="list-style-type: none"> • 1 invalid geometry • 3 multipart 	<ul style="list-style-type: none"> • 5 Null or BLANK cells • 3.9% Null or BLANK 			
	ENV_FIRM	<ul style="list-style-type: none"> • 121 cutback vertex • 60 duplicate vertex • 5 multipart 	<ul style="list-style-type: none"> • 8 fields • 189 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_FIRM_GRI D	<ul style="list-style-type: none"> • 5 duplicate vertex 	<ul style="list-style-type: none"> • 9 fields • 46 features • 91 Null or BLANK cells • 22% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_FIRM_GRI D_OLD	<ul style="list-style-type: none"> • 17 duplicate vertex 	<ul style="list-style-type: none"> • 9 fields • 42 features • 64 Null or BLANK cells • 16.9% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_FIRM_GRI D_Tbl	<ul style="list-style-type: none"> • 5 duplicate vertex 	<ul style="list-style-type: none"> • 11 fields • 46 features • 101 Null or BLANK cells • 20% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ENV_FIRM_LINE	<ul style="list-style-type: none"> • 15 cutbacks • 4 dangles • 58 duplicate vertex • 3 invalid geometry • 14 orphan 	<ul style="list-style-type: none"> • 4 fields • 1008 features • 6 Null or BLANK cells • 0.1% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_FUEL_MO DIFICATION_ZONE	<ul style="list-style-type: none"> • 16 cutback • 514 duplicate vertex 	<ul style="list-style-type: none"> • 11 fields • 831 features • 1207 Null or BLANK cells • 13.2% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	ENV_HYDROLOGY	<ul style="list-style-type: none"> • 29 cutback • 24 duplicate vertex 	<ul style="list-style-type: none"> • 5 fields • 182 features • 1 Null or BLANK cells • 0.1% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_HYDROLOGY_LINE	<ul style="list-style-type: none"> • 3 cutbacks • 23 duplicate vertex • 1 orphan 	<ul style="list-style-type: none"> • 4 fields • 1157 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ENV_LANDSLID E_POTENTIAL	<ul style="list-style-type: none"> • 402 cutback • 482 duplicate vertex • 83 multipart 	<ul style="list-style-type: none"> • 5 fields • 2726 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	ENV_LIQUEFAC TION_POTENTIAL	<ul style="list-style-type: none"> • 21 cutback • 17 duplicate vertex • 4 multipart 	<ul style="list-style-type: none"> • 5 fields • 102 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_MUNICIPAL FACILITIES	<ul style="list-style-type: none"> • 15 cutback • 57 duplicate vertex • 5 invalid geometry • 2 multipart 	<ul style="list-style-type: none"> • 16 fields • 149 features • 497 Null or BLANK cells • 20.8% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_OLDNCCP	<ul style="list-style-type: none"> • 21 cutback • 32 duplicate vertex • 6 multipart 	<ul style="list-style-type: none"> • 8 fields • 58 features • 10 Null or BLANK cells • 2.2% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ENV_SUBSIDEN CE	No incidents	<ul style="list-style-type: none"> • 5 fields • 4 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_WQMP	<ul style="list-style-type: none"> • 4 cutback • 12 duplicate vertex • 4 multipart 	<ul style="list-style-type: none"> • 6 fields • 15 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ENV_WQMP_A REAS	<ul style="list-style-type: none"> • 28 cutback • 218 duplicate vertex • 21 invalid geometry • 48 multipart 	<ul style="list-style-type: none"> • 23 fields • 2401 features • 19633 Null or BLANK cells • 35.6% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	GC_BLView	<ul style="list-style-type: none"> • 53 duplicate geometry 	<ul style="list-style-type: none"> • 28 fields • 18492 features • 67957 Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
			<ul style="list-style-type: none"> cells • 13.1% Null or BLANK 			
	GLClaims	No incidents	<ul style="list-style-type: none"> • 17 fields • 291 features • 123 Null or BLANK cells • 2.5% Null or BLANK 		Low	Transition to a standard data schema.
	GP_ACCIDENT_POTENTIAL_ZONE	No incidents	<ul style="list-style-type: none"> • 5 fields • 2 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_AIRPORT_NOISE	<ul style="list-style-type: none"> • 3 multipart 	<ul style="list-style-type: none"> • 5 fields • 4 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_AIRPORTS	<ul style="list-style-type: none"> • 1 multipart 	<ul style="list-style-type: none"> • 5 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	GP_ARTERIAL_L INE	<ul style="list-style-type: none"> • 8 dangles • 86 duplicate vertex • 4 invalid geometry • 2 multipart • 2 orphan 	<ul style="list-style-type: none"> • 6 fields • 773 features • 764 Null or BLANK cells • 16.5% Null or BLANK 		Low	Transition to a standard data schema.
	GP_ARTERIAL_P T	No incidents	<ul style="list-style-type: none"> • 2 fields • 43 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_BIKETRAILS _LINE	<ul style="list-style-type: none"> • 5 dangles • 88 duplicate vertex • 1 invalid geometry • 1 multipart • 2 orphan 	<ul style="list-style-type: none"> • 5 fields • 922 features • 924 Null or BLANK cells • 20% Null or BLANK 		Low	Transition to a standard data schema.
	GP_BIOTICRE	<ul style="list-style-type: none"> • 11 cutback • 14 duplicate vertex • 4 multipart 	<ul style="list-style-type: none"> • 6 fields • 39 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						standard data schema.
	GP_BIOTICRE_LI NE	<ul style="list-style-type: none"> • 4 cutbacks • 21 duplicate vertex • 126 orphan 	<ul style="list-style-type: none"> • 5 fields • 264 features • 32 Null or BLANK cells • 2.4% Null or BLANK 		Low	Transition to a standard data schema.
	GP_FUTURENIT M	No incidents	<ul style="list-style-type: none"> • 4 fields • 7 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_FUTURENIT M_LINE	No incidents	<ul style="list-style-type: none"> • 4 fields • 105 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_GENERALPL AN	<ul style="list-style-type: none"> • 103 cutback • 183 duplicate vertex • 5 invalid geometry • 29 multipart 	<ul style="list-style-type: none"> • 17 fields • 439 features • 1058 Null or BLANK cells • 14.2% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	GP_GEOHAZARD	<ul style="list-style-type: none"> • 248 cutback • 291 duplicate vertex • 7 multipart 	<ul style="list-style-type: none"> • 5 fields • 376 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_GREATPARK_OVERLAY	<ul style="list-style-type: none"> • 6 cutback • 31 duplicate vertex • 1 multipart 	<ul style="list-style-type: none"> • 9 fields • 44 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_GREATPARK_ROW_LINE	<ul style="list-style-type: none"> • 1 cutbacks • 2 dangles • 2 duplicate vertex • 11 orphan 	<ul style="list-style-type: none"> • 3 fields • 69 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_HIKINGTRAILS_LINE	<ul style="list-style-type: none"> • 2 duplicate vertex • 3 orphan 	<ul style="list-style-type: none"> • 3 fields • 15 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_HIST_ARCHEO_LINE	<ul style="list-style-type: none"> • 2 orphan 	<ul style="list-style-type: none"> • 5 fields • 2 features • 0 Null or BLANK cells • 0% Null or BLANK 	High rates of disconnection (>50%)	Medium	Heads-up digitizing, and potential on-site verification, to improve geometric

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						accuracy. Transition to a standard data schema.
	GP_HIST_ARCH EO_PT	No incidents	<ul style="list-style-type: none"> • 4 fields • 37 features • 18 Null or BLANK cells • 12.2% Null or BLANK 		Low	Transition to a standard data schema.
	GP_IMPLEMENTATION_DISTRICT	<ul style="list-style-type: none"> • 23 cutback • 18 duplicate vertex • 1 multipart 	<ul style="list-style-type: none"> • 6 fields • 77 features • 45 Null or BLANK cells • 9.7% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	GP_IMPLEMENTATION_DISTRICT_LINE	<ul style="list-style-type: none"> • 4 cutbacks • 16 duplicate vertex • 3 orphan 	<ul style="list-style-type: none"> • 4 fields • 487 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_JE_PRELIMINARYTRACTS	<ul style="list-style-type: none"> • 2 cutback • 14 duplicate 	<ul style="list-style-type: none"> • 20 fields • 24 features • 135 Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		<ul style="list-style-type: none"> vertex • 2 multipart 	<ul style="list-style-type: none"> cells • 28.1% Null or BLANK 			
	GP_LANDFORM	<ul style="list-style-type: none"> • 40 cutback • 75 duplicate vertex • 15 multipart 	<ul style="list-style-type: none"> • 6 fields • 218 features • 2 Null or BLANK cells • 0.2% Null or BLANK 		Low	Transition to a standard data schema.
	GP_LANDFORM_LINE	<ul style="list-style-type: none"> • 1 dangles • 1 duplicate vertex • 1 orphan 	<ul style="list-style-type: none"> • 3 fields • 33 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_LEVEL_OF_SERVICE_E_STANDARDS	<ul style="list-style-type: none"> • 4 duplicate vertex • 1 invalid geometry 	<ul style="list-style-type: none"> • 5 fields • 9 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_OPENSPACE	<ul style="list-style-type: none"> • 1 cutback • 6 duplicate vertex 	<ul style="list-style-type: none"> • 4 fields • 23 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_OPERATION_LINE	<ul style="list-style-type: none"> • 11 dangles • 20 duplicate 	<ul style="list-style-type: none"> • 5 fields • 654 features 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		<ul style="list-style-type: none"> vertex • 2multipart 	<ul style="list-style-type: none"> • 6 Null or BLANK cells • 0.2% Null or BLANK 			
	GP_OPERATION_PT	No incidents	<ul style="list-style-type: none"> • 2 fields • 43 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_PALEOSITE_PT	No incidents	<ul style="list-style-type: none"> • 3 fields • 74 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	GP_PALEOZONE	<ul style="list-style-type: none"> • 9 cutback • 6 duplicate vertex • 3 multipart 	<ul style="list-style-type: none"> • 5 fields • 25 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_PLANAREA	<ul style="list-style-type: none"> • 10 cutback • 16 duplicate vertex 	<ul style="list-style-type: none"> • 7 fields • 38 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_PLANAREA_SUBDIV	<ul style="list-style-type: none"> • 10 cutback • 18 duplicate vertex 	<ul style="list-style-type: none"> • 8 fields • 43 features 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
			<ul style="list-style-type: none"> • 0 Null or BLANK cells • 0% Null or BLANK 			
	GP_PRESERVATI ON_AREA	<ul style="list-style-type: none"> • 5 cutback • 3 duplicate vertex • 2 multipart 	<ul style="list-style-type: none"> • 5 fields • 12 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_PUBLICTRA NSIT_LINE	<ul style="list-style-type: none"> • 6 dangles • 12 duplicate vertex • 4 invalid geometry • 2 multipart • 1 orphan 	<ul style="list-style-type: none"> • 4 fields • 755 features • 1 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_PUBLICTRA NSIT_PT	No incidents	<ul style="list-style-type: none"> • 2 fields • 3 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_PUBSAFETY _PT	No incidents	<ul style="list-style-type: none"> • 7 fields • 24 features • 20 Null or BLANK cells • 11.9% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	GP_REGGEO	<ul style="list-style-type: none"> • 24 cutback • 1 duplicate vertex • 5 multipart 	<ul style="list-style-type: none"> • 5 fields • 76 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_REGGEO_LINE	<ul style="list-style-type: none"> • 8 orphan 	<ul style="list-style-type: none"> • 4 fields • 248 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_REGGEO2_PT	No incidents	<ul style="list-style-type: none"> • 2 fields • 18 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_REGIONAL99	<ul style="list-style-type: none"> • 26 cutback • 12 duplicate vertex • 15 multipart 	<ul style="list-style-type: none"> • 8 fields • 139 features • 104 Null or BLANK cells • 9.4% Null or BLANK 		Low	Transition to a standard data schema.
	GP_RESERVE_AREA	<ul style="list-style-type: none"> • 11 cutback • 21 duplicate vertex • 4 invalid 	<ul style="list-style-type: none"> • 8 fields • 30 features • 35 Null or BLANK cells • 14.6% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		<ul style="list-style-type: none"> geometry • 4 multipart 				
	GP_RIDGELINE	<ul style="list-style-type: none"> • 7 cutbacks • 17 duplicate vertex • 3 orphan 	<ul style="list-style-type: none"> • 3 fields • 40 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_SCENIC_HIG HWAY_LINE	<ul style="list-style-type: none"> • 1 cutbacks • 3 duplicate vertex • 1multipart • 3 orphan 	<ul style="list-style-type: none"> • 4 fields • 31 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GP_SENSITIVE_ SPECIES_PT	No incidents	<ul style="list-style-type: none"> • 19 fields • 1836 features • 1627 Null or BLANK cells • 4.7% Null or BLANK 		Low	Transition to a standard data schema.
	GP_SLOPE	<ul style="list-style-type: none"> • 208 cutback • 374 duplicate vertex • 14 multipart 	<ul style="list-style-type: none"> • 6 fields • 674 features • 8 Null or BLANK cells • 0.2% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	GP_SOIL	<ul style="list-style-type: none"> • 347 cutback • 703 duplicate vertex • 36 multipart 	<ul style="list-style-type: none"> • 6 fields • 1125 features • 109 Null or BLANK cells • 1.6% Null or BLANK 		Low	Transition to a standard data schema.
	GP_TENTATIVE_TRACT	No incidents	<ul style="list-style-type: none"> • 7 fields • 9 features • 18 Null or BLANK cells • 28.6% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	GP_TENTATIVE_TRACT_LINE	<ul style="list-style-type: none"> • 112 dangles • 174 duplicate vertex • 4 orphan 	<ul style="list-style-type: none"> • 4 fields • 1236 features • 41 Null or BLANK cells • 0.8% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	GP_TENTATIVE_TRACT_POINT	No incidents	<ul style="list-style-type: none"> • 56 fields • 560 features • 2240 Null or BLANK cells • 7.1% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	GP_WASTE_LINE	<ul style="list-style-type: none"> • 2 orphan 	<ul style="list-style-type: none"> • 3 fields • 2 features • 0 Null or BLANK cells • 0% Null or BLANK 	High rates of disconnection (>50%)	Medium	Heads-up digitizing, and potential on-site verification, to improve geometric accuracy. Transition to a standard data schema.
	GP_WASTE_PT	No incidents	<ul style="list-style-type: none"> • 2 fields • 7 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	GR8F	<ul style="list-style-type: none"> • 11 cutback • 74 duplicate vertex • 9 invalid geometry • 20 multipart 	<ul style="list-style-type: none"> • 36 fields • 170 features • 2588 Null or BLANK cells • 42.3% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						standard data schema.
	Grading_Sites_ At_GratePark	<ul style="list-style-type: none"> • 2 cutback • 9 duplicate vertex • 3 invalid geometry • 1 multipart 	<ul style="list-style-type: none"> • 33 fields • 12 features • 160 Null or BLANK cells • 40.4% Null or BLANK 	Missing significant attribution	High	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Repair geometry after review. Transition to a standard data schema.
	Grading_Sites_ At_GratePark_1	<ul style="list-style-type: none"> • 2 cutback • 9 duplicate vertex • 3 invalid 	<ul style="list-style-type: none"> • 33 fields • 12 features • 173 Null or BLANK cells • 43.7% Null or BLANK 	Missing significant attribution	High	Attribute rectification through field consolidation and the population of

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		geometry • 1 multipart				null values via research or on-site collection. Repair geometry after review. Transition to a standard data schema.
	GRADINGPOLY	• 114 cutback • 722 duplicate vertex • 25 invalid geometry • 50 multipart	• 16 fields • 1870 features • 9295 Null or BLANK cells • 31.1% Null or BLANK	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	GREATPARK_LI NE	<ul style="list-style-type: none"> • 7 cutbacks • 47 dangles • 235 duplicate vertex • 1 multipart • 5 orphan 	<ul style="list-style-type: none"> • 12 fields • 1075 features • 2076 Null or BLANK cells • 16.1% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	GREATPARK_PO LY	<ul style="list-style-type: none"> • 59 cutback • 84 duplicate vertex • 15 multipart 	<ul style="list-style-type: none"> • 14 fields • 139 features • 834 Null or BLANK cells • 42.9% Null or BLANK 	Missing significant attribution	High	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Repair geometry after review. Transition to a standard data schema.
	GRNF	<ul style="list-style-type: none"> • 3 cutback • 40 duplicate vertex 	<ul style="list-style-type: none"> • 36 fields • 66 features • 972 Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		<ul style="list-style-type: none"> • 4 invalid geometry • 11 multipart 	cells <ul style="list-style-type: none"> • 40.9% Null or BLANK 			consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	GRPF	<ul style="list-style-type: none"> • 7 cutback • 63 duplicate vertex • 7 invalid geometry • 14 multipart 	<ul style="list-style-type: none"> • 36 fields • 150 features • 2241 Null or BLANK cells • 41.5% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	INTNETG_1	No incidents	<ul style="list-style-type: none"> • 17 fields • 7204 features • 61352 Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
			cells <ul style="list-style-type: none"> • 50.1% Null or BLANK 			consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	Irv_Volunteers_XYEvents	No incidents	<ul style="list-style-type: none"> • 18 fields • 625 features • 4210 Null or BLANK cells • 37.4% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	Land_1000ft_buffer	<ul style="list-style-type: none"> • 254 cutback vertex • 2737 duplicate vertex 	<ul style="list-style-type: none"> • 6 fields • 5744 features 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		<ul style="list-style-type: none"> • 6 invalid geometry • 47 multipart 	<ul style="list-style-type: none"> • 0 Null or BLANK cells • 0% Null or BLANK 			
	Land_1000ft_buffer_OLD	<ul style="list-style-type: none"> • 266 cutback vertex • 3045 duplicate geometry • 5 invalid geometry • 54 multipart 	<ul style="list-style-type: none"> • 9 fields • 6515 features • 13943 Null or BLANK cells • 23.8% Null or BLANK 		Low	Transition to a standard data schema.
	MISC_FIBEROPTIC_CABLE_LINE	<ul style="list-style-type: none"> • 4 cutbacks • 4 dangles • 94 duplicate vertex • 29 orphan 	<ul style="list-style-type: none"> • 5 fields • 2776 features • 998 Null or BLANK cells • 7.2% Null or BLANK 		Low	Transition to a standard data schema.
	MISC_OCEAN	No incidents	<ul style="list-style-type: none"> • 4 fields • 1 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	MISC_OUTCITY	<ul style="list-style-type: none"> • 2 duplicate vertex • 1 multipart 	<ul style="list-style-type: none"> • 5 fields • 2 features 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
			<ul style="list-style-type: none"> • 0 Null or BLANK cells • 0% Null or BLANK 			
	NORTH_ZONE	<ul style="list-style-type: none"> • 7 cutback • 23 duplicate vertex • 1 multipart 	<ul style="list-style-type: none"> • 9 fields • 57 features • 55 Null or BLANK cells • 10.7% Null or BLANK 		Low	Transition to a standard data schema.
	PAF	<ul style="list-style-type: none"> • 58 cutback • 62 duplicate vertex • 26 multipart 	<ul style="list-style-type: none"> • 33 fields • 13826 features • 202933 Null or BLANK cells • 44.5% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	ParkingVariance	<ul style="list-style-type: none"> • 1 duplicate vertex • 1 orphan 	<ul style="list-style-type: none"> • 14 fields • 1 features • 1 Null or BLANK cells • 7.1% Null or BLANK 	High rates of disconnection (>50%)	Medium	Heads-up digitizing, and potential on-site verification, to

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						improve geometric accuracy. Transition to a standard data schema.
	PRE1994_BUILDING_TRACTS	<ul style="list-style-type: none"> • 72 cutback • 842 duplicate vertex • 39 invalid geometry • 129 multipart 	<ul style="list-style-type: none"> • 7 fields • 2557 features • 1999 Null or BLANK cells • 11.2% Null or BLANK 		Low	Transition to a standard data schema.
	Project_Sites	No incidents	<ul style="list-style-type: none"> • 19 fields • 167 features • 303 Null or BLANK cells • 9.5% Null or BLANK 		Low	Transition to a standard data schema.
	Project_Sites_Update_All	<ul style="list-style-type: none"> • 67 cutback • 73 duplicate vertex • 29 multipart 	<ul style="list-style-type: none"> • 5 fields • 13891 features • 9 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	Project_Sites_Update_Grade	<ul style="list-style-type: none"> • 17 cutback vertex • 16 invalid geometry • 28 multipart 	<ul style="list-style-type: none"> • 8 fields • 196 features • 185 Null or BLANK cells • 11.8% Null or BLANK 		Low	Transition to a standard data schema.
	PW_LARGE_MONUMENT	No incidents	<ul style="list-style-type: none"> • 6 fields • 3 features • 3 Null or BLANK cells • 16.7% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	PW_METAL_MONUMENT	No incidents	<ul style="list-style-type: none"> • 6 fields • 64 features • 115 Null or BLANK cells • 29.9% Null or BLANK 		Low	Transition to a standard data schema.
	PW_MIDSIZE_MONUMENT	No incidents	<ul style="list-style-type: none"> • 6 fields • 25 features • 27 Null or BLANK cells • 18% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	PW_PRIVATE_MONUMENT	<ul style="list-style-type: none"> • 2 duplicate geometry 	<ul style="list-style-type: none"> • 6 fields • 68 features • 58 Null or BLANK cells • 14.2% Null or BLANK 		Low	Transition to a standard data schema.
	RoadClosureIntersection	No incidents	<ul style="list-style-type: none"> • 11 fields • 6 features • 0 Null or BLANK cells • 0% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	RoadClosureSegment	<ul style="list-style-type: none"> • 1 cutbacks • 2 duplicate vertex • 1 multipart • 10 orphan 	<ul style="list-style-type: none"> • 12 fields • 20 features • 90 Null or BLANK cells • 37.5% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	SCAG_LAND_US E_2012	<ul style="list-style-type: none"> • 882 cutback • 18426 duplicate vertex • 1 invalid geometry • 133 multipart 	<ul style="list-style-type: none"> • 14 fields • 39799 features • 121 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	SCAG_SPZ_V20	<ul style="list-style-type: none"> • 156 cutback • 1459 duplicate vertex • 33 multipart 	<ul style="list-style-type: none"> • 17 fields • 1530 features • 1530 Null or BLANK cells • 5.9% Null or BLANK 		Medium	Repair geometry after review. Transition to a standard data schema.
	SCAG_TAZ_TIER _1_2010	<ul style="list-style-type: none"> • 17 cutback • 38 duplicate vertex • 13 multipart 	<ul style="list-style-type: none"> • 11 fields • 72 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	SCAG_TAZ_TIER _2_2010	<ul style="list-style-type: none"> • 36 cutback • 73 duplicate vertex • 6 multipart 	<ul style="list-style-type: none"> • 22 fields • 203 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	SIP	<ul style="list-style-type: none"> • 36 cutbacks • 262 dangles • 2283 duplicate 	<ul style="list-style-type: none"> • 11 fields • 11964 features • 25691 Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
		vertex • 81 invalid geometry • 4 multipart • 326 orphan	cells • 19.5% Null or BLANK			
	SIP_CIP	No incidents	empty feature class or table		FALSE	Verify necessity and revise as appropriate
	SpeedTrailer	No incidents	• 5 fields • 3 features • 0 Null or BLANK cells • 0% Null or BLANK		Low	Transition to a standard data schema.
	STREET_SWEEPI NG_INHOUSE_C ONTRACT	• 13 cutback • 32 duplicate vertex • 6 invalid geometry	• 5 fields • 42 features • 1 Null or BLANK cells • 0.5% Null or BLANK		Medium	Repair geometry after review. Transition to a standard data schema.
	STREET_SWEEPI NG_SCHEDULE	• 5 cutback • 24 duplicate vertex • 1 multipart	• 6 fields • 28 features • 0 Null or BLANK cells • 0% Null or BLANK		Medium	Repair geometry after review. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	TomTom_Clipped	<ul style="list-style-type: none"> • 2 dangles • 1052 duplicate vertex • 16 orphan 	<ul style="list-style-type: none"> • 25 fields • 198617 features • 1529216 Null or BLANK cells • 30.8% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	TomTom_Clipped2	<ul style="list-style-type: none"> • 1051 duplicate vertex • 18 orphan 	<ul style="list-style-type: none"> • 23 fields • 198734 features • 2050758 Null or BLANK cells • 44.9% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	Tracts	<ul style="list-style-type: none"> • 5 cutback • 32 duplicate vertex • 3 invalid geometry • 7 multipart 	<ul style="list-style-type: none"> • 9 fields • 180 features • 197 Null or BLANK cells • 12.2% Null or BLANK 		Low	Transition to a standard data schema.
	Waste	No incidents	<ul style="list-style-type: none"> • 7 fields • 6 features • 3 Null or BLANK cells • 7.1% Null or BLANK 		Low	Transition to a standard data schema.
	ZONING	<ul style="list-style-type: none"> • 117 cutback • 1287 duplicate vertex • 72 invalid geometry • 42 multipart 	<ul style="list-style-type: none"> • 14 fields • 1625 features • 5263 Null or BLANK cells • 23.1% Null or BLANK 		Low	Transition to a standard data schema.
	ZONING_Intersect	No incidents	<ul style="list-style-type: none"> • 37 fields • 36554 features • 191568 Null or BLANK cells • 14.2% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ZONING_LABEL	No incidents	<ul style="list-style-type: none"> • 8 fields • 922 features • 885 Null or BLANK cells • 12% Null or BLANK 		Low	Transition to a standard data schema.
	ZONING_LABEL_pa30Base	No incidents	<ul style="list-style-type: none"> • 10 fields • 16 features • 48 Null or BLANK cells • 30% Null or BLANK 		Low	Transition to a standard data schema.
	ZONING_LABEL_pa30OVERLAY	No incidents	<ul style="list-style-type: none"> • 10 fields • 16 features • 48 Null or BLANK cells • 30% Null or BLANK 		Low	Transition to a standard data schema.
	ZONING_LABEL_pa51Base	No incidents	<ul style="list-style-type: none"> • 10 fields • 36 features • 109 Null or BLANK cells • 30.3% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						collection. Transition to a standard data schema.
	ZONING_PROP OSED	<ul style="list-style-type: none"> • 96 cutback vertex • 1205 duplicate geometry • 44 invalid geometry • 14 multipart 	<ul style="list-style-type: none"> • 12 fields • 1489 features • 2016 Null or BLANK cells • 11.3% Null or BLANK 		Low	Transition to a standard data schema.
	ZONING_PT	<ul style="list-style-type: none"> • 144 duplicate geometry 	<ul style="list-style-type: none"> • 8 fields • 1636 features • 2291 Null or BLANK cells • 17.5% Null or BLANK 		Low	Transition to a standard data schema.
	ASSORTOLAND	No incidents	<ul style="list-style-type: none"> • 9 fields • 94575 features • 42701 Null or BLANK cells • 5% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	BLDGADDRESS	No incidents	<ul style="list-style-type: none"> • 22 fields • 126328 features • 701447 Null or BLANK cells • 25.2% Null or BLANK 		Low	Transition to a standard data schema.
	BLDGADDRESS_1000FT_BUFFER	No incidents	<ul style="list-style-type: none"> • 16 fields • 12916 features • 54373 Null or BLANK cells • 26.3% Null or BLANK 		Low	Transition to a standard data schema.
	BLDGADDRESS_20180104_temp	No incidents	<ul style="list-style-type: none"> • 22 fields • 122657 features • 684612 Null or BLANK cells • 25.4% Null or BLANK 		Low	Transition to a standard data schema.
	BLDGADDRESS_20180108	No incidents	<ul style="list-style-type: none"> • 22 fields • 122753 features • 703696 Null or BLANK cells • 26.1% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	BLDGADDRESS_WBUFFER	No incidents	<ul style="list-style-type: none"> • 26 fields • 139244 features • 1364460 Null or BLANK cells • 37.7% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	BUSLICENSE_WBIN	No incidents	<ul style="list-style-type: none"> • 29 fields • 14325 features • 39793 Null or BLANK cells • 9.6% Null or BLANK 		Low	Transition to a standard data schema.
	DPLANAREA	No incidents	<ul style="list-style-type: none"> • 3 fields • 40 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ESMPRMTR_PIN_SUBSET	No incidents	<ul style="list-style-type: none"> • 12 fields • 383403 features • 250825 Null or BLANK cells • 5.5% Null or BLANK 		Low	Transition to a standard data schema.
	Grading_Sites_At_GratePark__ATTACH	No incidents	<ul style="list-style-type: none"> • 6 fields • 1 features • 1 Null or BLANK cells • 16.7% Null or BLANK 		Low	Transition to a standard data schema.
	Grading_Sites_At_GratePark__ATTACH_1	No incidents	<ul style="list-style-type: none"> • 6 fields • 1 features • 1 Null or BLANK cells • 16.7% Null or BLANK 		Low	Transition to a standard data schema.
	GREA	No incidents	<ul style="list-style-type: none"> • 28 fields • 5237 features • 74750 Null or BLANK cells • 51% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						standard data schema.
	GREA_20140930	No incidents	<ul style="list-style-type: none"> • 28 fields • 4544 features • 64950 Null or BLANK cells • 51% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	GREA_2016	No incidents	<ul style="list-style-type: none"> • 28 fields • 4880 features • 69676 Null or BLANK cells • 51% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
						standard data schema.
	LIABILITY_CLAI MS_Doc	No incidents	<ul style="list-style-type: none"> • 20 fields • 1308 features • 6195 Null or BLANK cells • 23.7% Null or BLANK 		Low	Transition to a standard data schema.
	PEA	No incidents	<ul style="list-style-type: none"> • 28 fields • 44894 features • 676498 Null or BLANK cells • 53.8% Null or BLANK 	Missing significant attribution	Medium	Attribute rectification through field consolidation and the population of null values via research or on-site collection. Transition to a standard data schema.
	vw_AddressLoo kup	No incidents	<ul style="list-style-type: none"> • 3 fields • 126328 features • 516 Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
			cells • 0.1% Null or BLANK			
	vw_BLDG_XY_SINGLEFIELD	No incidents	• 4 fields • 126328 features • 516 Null or BLANK cells • 0.1% Null or BLANK		Low	Transition to a standard data schema.
	vw_BLDGADDRESS	No incidents	• 8 fields • 140 features • 123 Null or BLANK cells • 11% Null or BLANK		Low	Transition to a standard data schema.
	vw_BusLicense	No incidents	empty feature class or table		FALSE	Verify necessity and revise as appropriate
	vw_CtyPropID_SIREDocID	No incidents	• 4 fields • 666 features • 119 Null or BLANK cells • 4.5% Null or BLANK		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	VW_STREETNO DES	No incidents	<ul style="list-style-type: none"> • 3 fields • 12132 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	VW_STREETNO DES_1	No incidents	<ul style="list-style-type: none"> • 3 fields • 11240 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	VW_STREETNO DES_GC	No incidents	<ul style="list-style-type: none"> • 3 fields • 11240 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	vwAddress	No incidents	<ul style="list-style-type: none"> • 4 fields • 126328 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	vwAddress_acti ves	No incidents	<ul style="list-style-type: none"> • 4 fields • 125417 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	Waste__ATTACH	No incidents	<ul style="list-style-type: none"> • 6 fields • 4 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.
	ZONE_DESC	No incidents	<ul style="list-style-type: none"> • 4 fields • 90 features • 0 Null or BLANK cells • 0% Null or BLANK 		Low	Transition to a standard data schema.

Dataset	Layer	Geometric Accuracy	Attribution	Comments	Level of Effort to Resolve Issues	Best Method to Improve Accuracy and Completeness
	ZONINGLUT	No incidents	<ul style="list-style-type: none"> • 5 fields • 89 features • 178 Null or BLANK cells • 40% Null or BLANK 	Missing significant attribution	Medium	<p>Attribute rectification through field consolidation and the population of null values via research or on-site collection.</p> <p>Transition to a standard data schema.</p>

Technology Readiness Assessment

City of Irvine | CA

Table of Contents

- Introduction 1
- Major System Architecture Tasks..... 2
- Central Server and Service Oriented Architecture Approach 3
- Methods and Constraints..... 4
 - Purpose and Methodology4
 - Assumptions and Constraints.....4
- Architecture Vision 5
- Business Architecture 7
 - Business Requirements2
 - IT Standards and Policies.....3
 - Hardware Virtualization.....2
 - Cloud Hosted Solutions.....2
 - Business Development Platform.....3
 - Relational Databases.....4
- Technology Architecture: Existing Conditions..... 6
- Technology Architecture: Recommendations 10
- Network Communications Review and Recommendations..... 15
- GIS Availability/Stability/Uptime 16
 - Emergency Event Response 16
 - 24/7 Response 17
 - Database Considerations..... 17
- System Architecture Design..... 19
 - Platform Sizing..... 19
 - Server and Software Performance 20
 - Configuration Recommendations..... 21
 - GIS Data Administration 22
 - Platform Performance..... 25
- Software Solutions and Interoperability..... 29

Existing Applications.....	29
Software Solutions and Options	29
Existing and Recommended GIS Integration with Business Systems	30
Web GIS (Intranet and Internet).....	32
ArcGIS Online	33
Portal for ArcGIS	35
Story Maps	36
ArcGIS Solutions	38
Mobile	41
Desktop	42
Extensions.....	45
Summary of Existing and Desired GIS Software	46
Licensing Analysis.....	46
Final Software Considerations.....	49

Introduction

This chapter reviews technology readiness, provides the design specification for an enterprise GIS, and addresses GIS software solutions appropriate to the business needs of the City of Irvine. The needs of the City were identified during interviews, and on-site reviews and requirements gathering. The needs emphasized the importance of maintaining a centralized system of shared GIS resources, improving geospatial and analytical capabilities, improving system reliability, and providing best of class system performance to GIS users.

Based on these findings and on other identified needs, the primary goals and objectives of this chapter are as follows:

- **Provide a sustainable platform for future system expansion**
- **Ensure the system is reliable and highly available**
- **Leverage best of class technology and hardware platform**
- **Provide industry Best Practices for improving the performance and efficiency of the GIS architecture**
- **Leverage industry best practices for software and interoperability as it relates to the enterprise GIS**

Major System Architecture Tasks

In the current City of Irvine GIS deployment, the two recommended major architectural tasks were identified. Recommended tasks in the current environment include:

- **Implement a new GIS architecture design as indicted in this plan to enable ROI from a full ArcGIS Enterprise implementation**
- **Create domain certificates and apply to all machines to fully support HTTPS traffic across all levels of the GIS**

To achieve a modern state-of-the-art municipal GIS and enable the City to take full advantage of its potential GIS ROI, the City of Irvine will first need to implement the recommended GIS environment that is detailed in this chapter. Several major tasks need to be planned and implemented to achieve this. These tasks are all part of a larger effort to refactor the existing GIS implementation and provide greater system stability, scalability, performance, and reliability. The major tasks are outlined below:

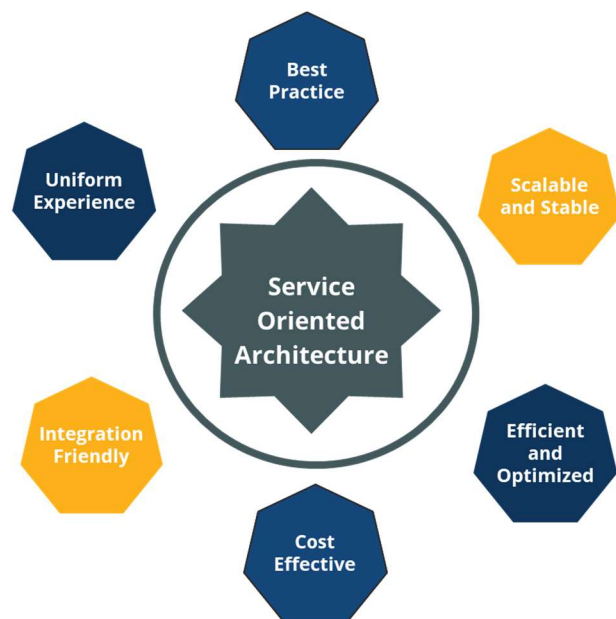
...to take full advantage of its potential GIS ROI, the City of Irvine will first need to implement the recommended GIS environment that is detailed in this chapter

- **Generate self signed HTTPS certificates for all machines behind the firewall the development, staging (testing), and production environments;**
- **If needed, create service accounts for the newly deployed machines and add the accounts to the appropriate Windows Active Directory role-stores;**
- **Install appropriate ArcGIS software on the newly deployed machines;**
- **Configure newly deployed machines with the existing GIS system across all three environments;**
- **Remove unnecessary software from existing GIS machines; and**
- **Promote the changes to production for system go-live.**

Central Server and Service Oriented Architecture Approach

To most effectively leverage both the GIS and IT infrastructures of the City, a centralized server and service oriented architecture (SOA) approach should be used. In an SOA, the management and distribution of resources is centralized and are exposed as consumable services across a network. This approach provides the administrative benefit of a consolidated infrastructure while also providing a uniform and distributed means of interacting with data, methods and information. In addition to simplifying the administration of a system, services allow for scalable, efficient and distributed consumption of those resources.

A service-oriented GIS leverages the power of Esri's enterprise GIS solution, ArcGIS Enterprise. A properly deployed ArcGIS Enterprise implementation leverages the computational benefits of servers and the GIS methods of Esri's technology to provide a uniform, scalable and performant mechanism to work with geospatial data and methods. This implementation strategy also optimizes the human resources the organization has by allowing IT professionals to maintain and administer the infrastructure while GIS professionals can spend their time managing geodata, executing spatial analysis and creating mapping products.



Methods and Constraints

Purpose and Methodology

This chapter is intended to communicate architectural observations and recommendations to improve Irvine's enterprise GIS. The information contained within this chapter was gathered through interviews, on-site reviews and requirements gathering sessions with the staff of Irvine and was synthesized by Geographic Technologies Group's enterprise GIS team. The recommendations are informed by industry best practices, the information obtained through GTG's interactions and conversations with the staff of Irvine, and by the collective experience and knowledge of GTG's staff.

GTG's design process, and the resultant content of this chapter, is derived from The Open Group Architecture Framework (TOGAF), Esri's Best Practices manual and GTG's project management standards.

Assumptions and Constraints

The approach and recommendations made in this chapter were generated under the following assumptions and within the context of the following constraints:

1. As appropriate, existing hardware will be considered for inclusion as part of a new or updated GIS architecture. Server hardware is assumed to be at the end of its production life cycle when it is 5 or more years old;
2. "User requirements" refers to the system's capacity to support its total user base in their current distribution across the network. The term does not refer to user applications or software requirements;
3. The target time frame for the designs in this chapter is a five-year period. Consequently, capacity calculations and recommendations are derived from the estimated peak user activity that could reasonably occur during that period; and
4. The information provided to and gathered by Geographic Technologies Group represents the true conditions of GIS, its users and its management at the City of Irvine.

Architecture Vision

Within the City of Irvine, GIS exists as both an IT service and a set of departmental functions and staff. As a result, the GIS architecture must reflect both the values and visions of the Information Technology Division and the GIS community within the City. Designing and implementing a sustainable, performant, and modern GIS to support Irvine must be both technically sound and resonate with the ideals and goals of the City, the IT Division and the greater GIS community.

The City of Irvine envisions an enterprise GIS that centralizes the core GIS within the organization and that leverages the resources of IT to manage and deliver exceptional services that are consumed and customized at the enterprise and departmental level. This approach conceptually leverages a “hub and spoke” architecture where the core GIS services are exposed as IT services which can be integrated with and extended into departmental operations. Such a system will ensure that GIS within the City is securely and expertly maintained on a robust infrastructure that facilitates and enhances the GIS and mapping communities of the City.

Irvine GIS subject matter experts (SMEs) will continue to operate at the departmental level, allowing the organization to best leverage its knowledge-base and resources. IT professionals will ensure that data and operations meet the City’s needs and can be allowed to implement solutions that will ensure data reliability, resiliency and structure. The GIS will be governed by a GIS steering committee that engages with both the IT staff maintaining the technology and the GIS community that is working directly with the GIS.



SUPPORT CORE SERVICES AND COST CONTAINMENT, WHILE INVESTING IN STRATEGIC INITIATIVES TO BETTER POSITION THE CITY AND TO LEVERAGE INNOVATIONS AND TECHNOLOGY TRENDS.

Irvine's IT Vision Statement

THE CITY OF IRVINE GIS SECTION, WHILE LOCATED IN THE IT DIVISION OF HUMAN RESOURCES AND INNOVATION, SERVES ALL CITY DEPARTMENTS AND THE CITIZENRY OF IRVINE. COMPOSED OF FULL AND PART TIME STAFF AS WELL AS INTERNS, OUR GOAL IS TO COLLECT, ANALYZE, AND DISSEMINATE CITY-WIDE GEOSPATIAL INFORMATION. INFORMATION IS PRESENTED IN THE FORM OF INTERACTIVE WEBSITES AND PAPER AND DIGITAL MAPS.

Irvine's GIS Vision Statement



As GIS continues to grow within the City, standardizing, documenting and governing will be prioritized and regularly updated to ensure that the GIS technology and GIS processes are following best practices and deliver effective results.

Business Architecture

This section details the business requirements, preferences and vision that guide the GIS design presented within the chapter. The GIS architecture and implementation detailed in this chapter is built to develop with the organization and provide opportunities for growth and change as identified by the business structure, plans and priorities. The business requirements are derived from GTG's conversations, meetings and design-sessions with the following Irvine departments and teams:

- Chief Information Officer
- Community Development
- Community Services
- Finance
- GIS
- Public Safety/CAD
 - Crime Analysis
 - Emergency Operations Center
- Public Works
- Records
- Transportation

Irvine's GIS business needs are discussed in detail in the following section.

Business Requirements

Geographic Technologies Group identified the following business requirements for the City of Irvine as driving motivators for the design, management and use of an enterprise GIS.

No.	Item	Description
1	Improve GIS governance practices and policies	Governance is a critical component of sustaining an enterprise GIS and allows the organization to manage its GIS resources and maintain a unified direction between stakeholders. Existing governance teams and policies need to be revisited and modified to meet the organization's needs
2	Provide stable, supported, and extensible GIS integration points	The city has several applications that directly or indirectly rely on the GIS, its data or its services. These dependencies need to be documented and maintained for continued support
3	Organize and align GIS community and processes	Departmental GIS communities, the enterprise GIS team and involved IT groups need to discuss the current processes in place and identify areas of improvement to execute as one
4	Develop a dataset census of internal resources	Spatial and non-spatial data is currently stored across the network and there is not yet a comprehensive catalog of the City's data resources. This information needs to be cataloged and maintained
5	Draft an ArcGIS Pro exploration plan	ArcGIS Pro is now Esri's premier desktop GIS software and the City needs to ensure that its users are comfortable with the technology and leverage the application to its fullest potential
6	Develop SOPs for GIS management and usage	Standard operating plans, rules of engagement and service level commitments/agreements should be drafted to standardize GIS processes and set organizational expectations
7	Investigate and document existing and required automation tools and tasks	Existing tasks and scripts need to be centrally documented and a process should be put in place to maintain this list

IT Standards and Policies

The City's GIS staff indicated that there are not currently any formal standards or policies that specifically govern the GIS, GIS users or GIS processes. The GIS staff informed GTG that a data standard that contractor must adhere to exists, but a comprehensive set of SOPs or "Rules of Engagement" policies to cover all of IT/GIS are not in place. These SOPs and policies should be created, adopted and shared in an accessible location to assist in setting organizational expectations.

GTG recommends that the following standards and policies documents be drafted and adopted by Irvine to more effectively and systemically manage its GIS resources, processes and users:

- **Service Level Commitment for GIS Services**
- **Change Control Process for GIS**
- **GIS User Onboarding Document**
- **Organizational Chart for GIS Community**
- **Security Standard**
- **Cloud Computing Standard**
- **Supported Technologies Standard**
- **GIS Steering Team Charter**
- **GIS Steering Committee Leadership Charter**
- **Organizational Rules of Engagement**
- **Spatial Metadata Standard**
- **Data Sharing Agreement**

Hardware Virtualization

Virtualization provides organizations with the ability to quickly, efficiently and cost-effectively deploy IT resources in their environment without the continued purchase of hardware. The City of Irvine currently uses VMWare as their virtualization software. GTG recommends that Irvine continue to leverage virtualized hardware, especially in support of their exploratory and developmental efforts.

As Irvine continues to develop their GIS community, scope and applications, virtualization will increasingly prove useful, especially in rapid-prototyping, scope-determination and in emergency events. The ability to quickly and methodically deploy hardware to support or extend the enterprise GIS is important and Irvine should maintain the appropriate images to support the enterprise GIS.

Cloud Hosted Solutions

The City of Irvine has indicated that the expanded use of cloud computing is a focus area for the City in the 2018 – 2023 Strategic Technology Plan. Currently, Irvine’s use of cloud services is limited. The City is utilizing Microsoft Office 365 and has declared Azure as the cloud service provider of choice. The City’s use of ArcGIS Online indirectly leverages the cloud via Esri’s reliance on Amazon Web Services (AWS). ArcGIS Online data is stored on Esri’s dedicated EC2 infrastructure within AWS. Esri’s cloud system and services are FEDRAMP certified, validating that Esri’s utilization of and practices surrounding its cloud infrastructure are secure.



**ArcGIS
Online**

As Irvine continues to grow, GTG recommends drafting a “Cloud Computing Standard” and engaging in exploratory efforts with an established cloud provider, such as Microsoft Azure as indicated in the 2018 – 2023 Strategic Technology Plan. It is recommended that the City also consider Amazon Web Services or Google Cloud, to see if the City can benefit from cloud services, storage or integrations from these providers. The cloud can offer both performance and cost efficiencies but should be thoroughly evaluated before deployment.



It is GTG's recommendation that IT, GIS and departmental leadership come together to discuss cloud options and begin on drafting an IT standard for cloud computing. This planning should be followed by an exploratory study and evaluation of cloud providers resulting in a determination of the cloud's feasibility for the organization now and in the future.

Business Development Platform

Continued growth at the City of Irvine requires a thoughtful and intentional effort to develop intelligently and manageability. Population growth in Irvine will continue to exert increasing stress on City IT and GIS resources and the internal response of the City will be critical to meeting residents and staff needs.

Currently, the City maintains several production systems, including:

- ArcGIS
- OnBase ECM (documents and records management)
- Progressive Solutions (business licensing)
- GoEnforce and Host Compliance (code enforcement)
- ePlanSoft (electronic plan check)
- In Forum Gold (Permitting)
- Central Square (finance)
- CivicRec (parks users)
- Lucity (asset management)
- Chameleon (animal control)
- Pavement management system
- Intergraph (CAD and RMS)



These systems have varying degrees of integrations and interplays with other systems. The users that utilize them need to be managed systemically through meaningful governance structures, clearly defined best practices, and open lines of communication.

It is GTG's recommendation that Irvine take actionable steps to "execute as one" to align its organizational values, staff and resources to achieve its goals. This process consists of:

- **Aligning the organization's leadership;**
- **Developing relationships across teams/departments;**
- **Drafting an organizational strategic plan with SMART (Strategic, Measurable, Achievable, Relevant, and Time-bound) goals;**
- **Establishing governance processes and teams to ensure best-practices are being followed, and;**
- **Reflecting on the progress throughout and after the process.**

This framework is also applicable for Irvine's GIS business; stakeholders should:

- **Align their interests and activities;**
- **Work to develop strong personal and professional relationships across teams;**
- **Articulate and commit to specific goals as they pertain to GIS**
- **Develop and implement effective and engaging governance structures, and;**
- **Strive for continuous improvement through regular evaluations.**

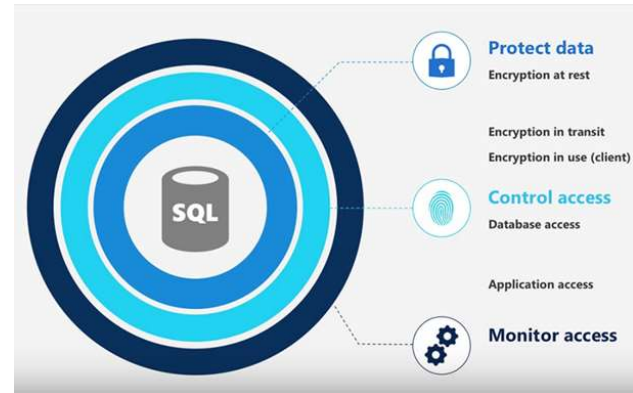
These efforts, coupled with continued work to demonstrate the value of GIS to senior leadership, executives, and elected officials, can significantly impact the role, scope, and value-add of GIS within the organization.

Relational Databases

The City of Irvine currently leverages Microsoft's SQL Server as its enterprise database platform supporting the enterprise GIS. The enterprise GIS is supported by Microsoft SQL Server 2016 that has been configured as an Esri enterprise geodatabase for more complete and native integration into the Esri ecosystem. This deployment method is best practice and

meets the organization's database needs in its current form and within the forecasted needs of the organization.

SQL Server meets the organization's needs of multi-user editing with version control, programmatic backup functionality, ownership-based access control, identity-provider based authentication (Windows authentication) and organizational access to the data.



While the enterprise GIS is supported by a SQL Server RDMS instance, there is still a lack of clarity about the organization's spatial and non-spatial data footprints. Meetings with Irvine staff have indicated that there is a need to develop a dataset census and a process to maintain this catalog. Upstream and downstream data dependencies are also not well documented, further necessitating the need for a dataset census.

Technology Architecture: Existing Conditions

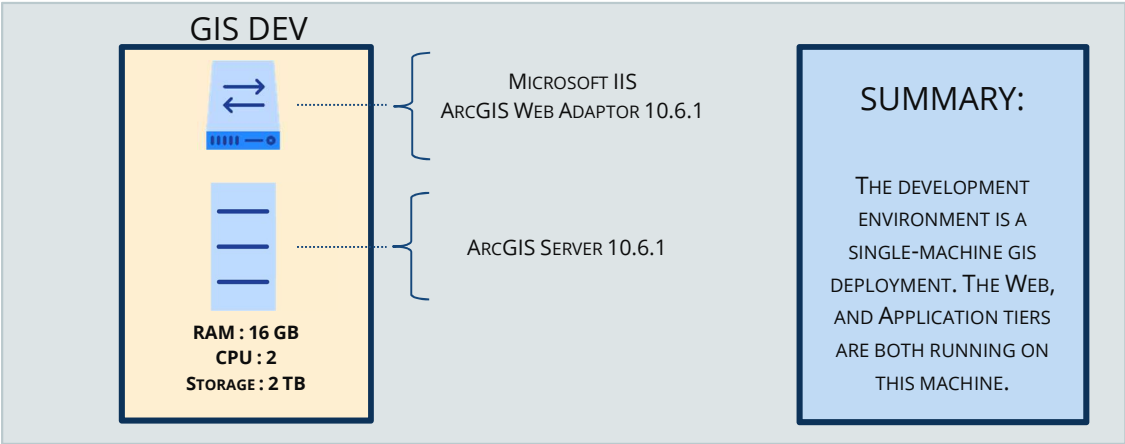
The current enterprise GIS deployment for the City of Irvine leverages a Microsoft SQL Server 2016 database backend, an ArcGIS Server 10.6.1 deployment at the application tier, and a Microsoft IIS web server at the web tier. The City maintains functioning development, staging (testing), and production environments to support its operations. Both an internal and external environment are in place.

The **current infrastructure** is summarized in the table below.

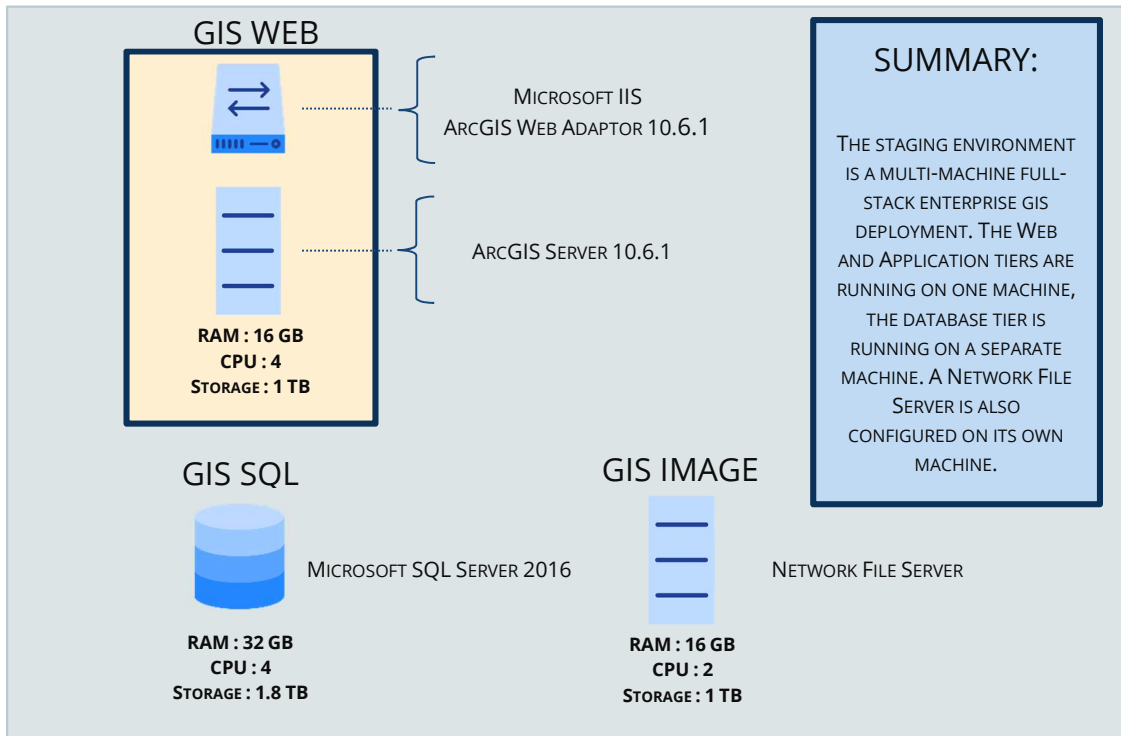
Machine	Environment	Endpoint	Function	Application(s)
GIS DEV	Development	Internal	Application & Web	ArcGIS Server (10.6.1), ArcGIS Web Adaptor (10.6.1)
GIS SQL	Staging	Internal	Database	SQL Server (2016)
GIS WEB	Staging	Internal	Application, Web	ArcGIS Server (10.6.1), ArcGIS Web Adaptor (10.6.1)
GIS IMAGE	Staging	Internal	Application	Network File Server
GIS SQL	Production	Internal	Database	SQL Server (2016)
GIS WEB	Production	Internal	Application, Web	ArcGIS Server (10.6.1), ArcGIS Web Adaptor (10.6.1)
GIS IMAGE	Production	Internal	Application	Network File Server
GIS WEB	Production	External	Web	Web Adaptor (10.6.1), ArcGIS Server, ArcGIS Portal (10.6.1)

In the City's current implementation, there are eight (8) active machines with several machines operating as single-stack deployments. The environments are grouped (colored) according to their environment.

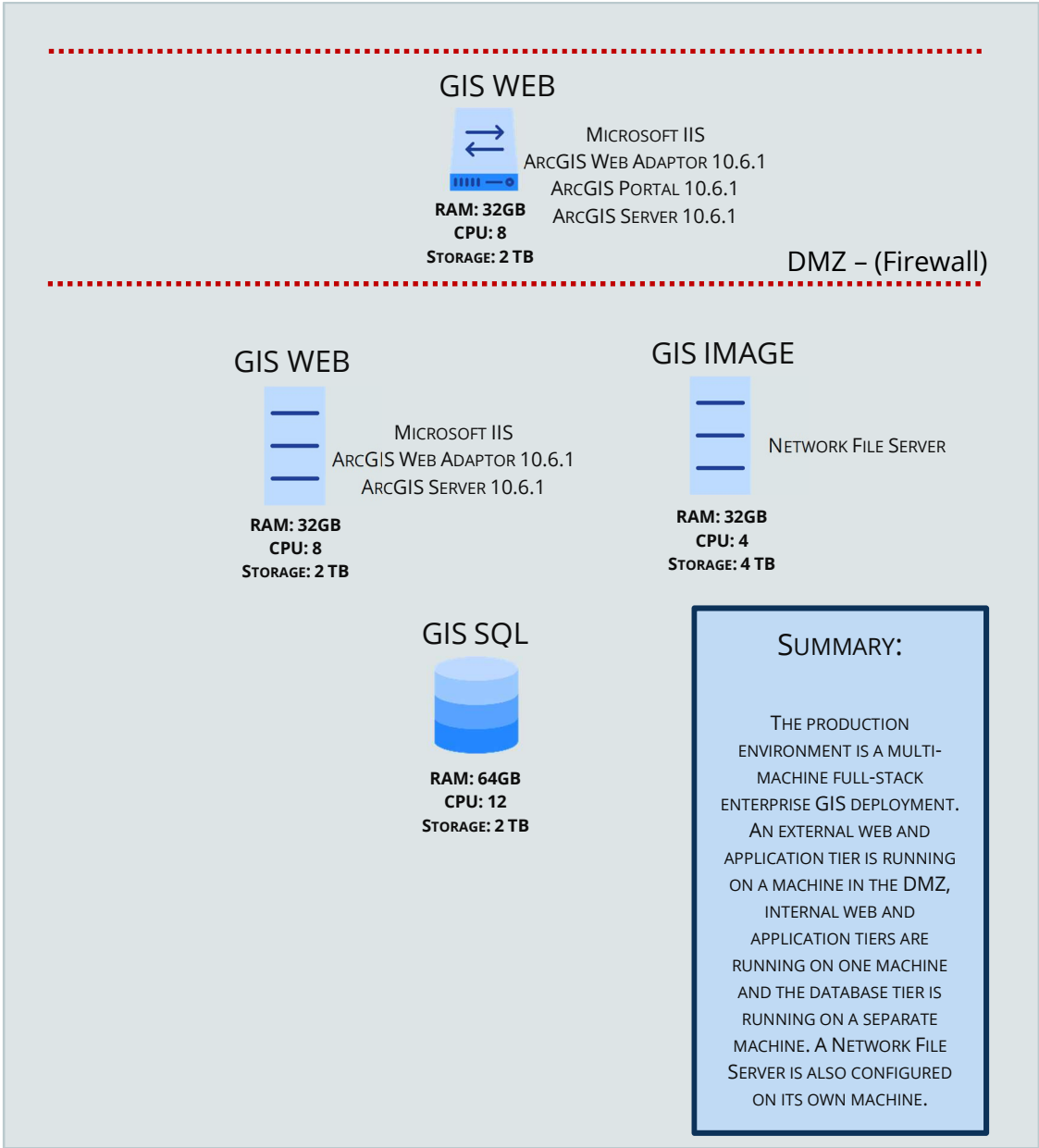
The **current development environment** is diagramed below:



The **current staging environment** is diagrammed below:



The **current production environment** is diagrammed below:

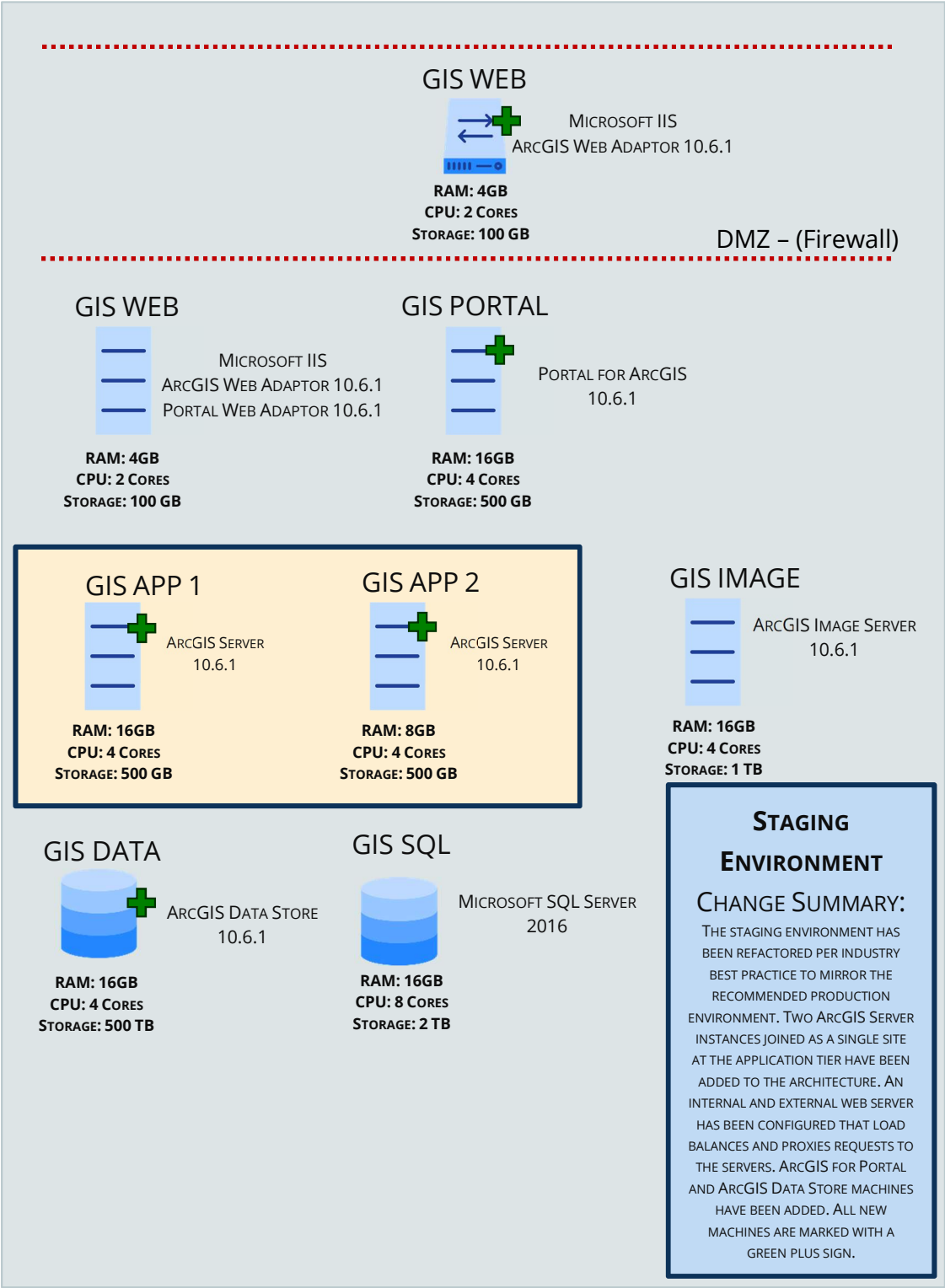


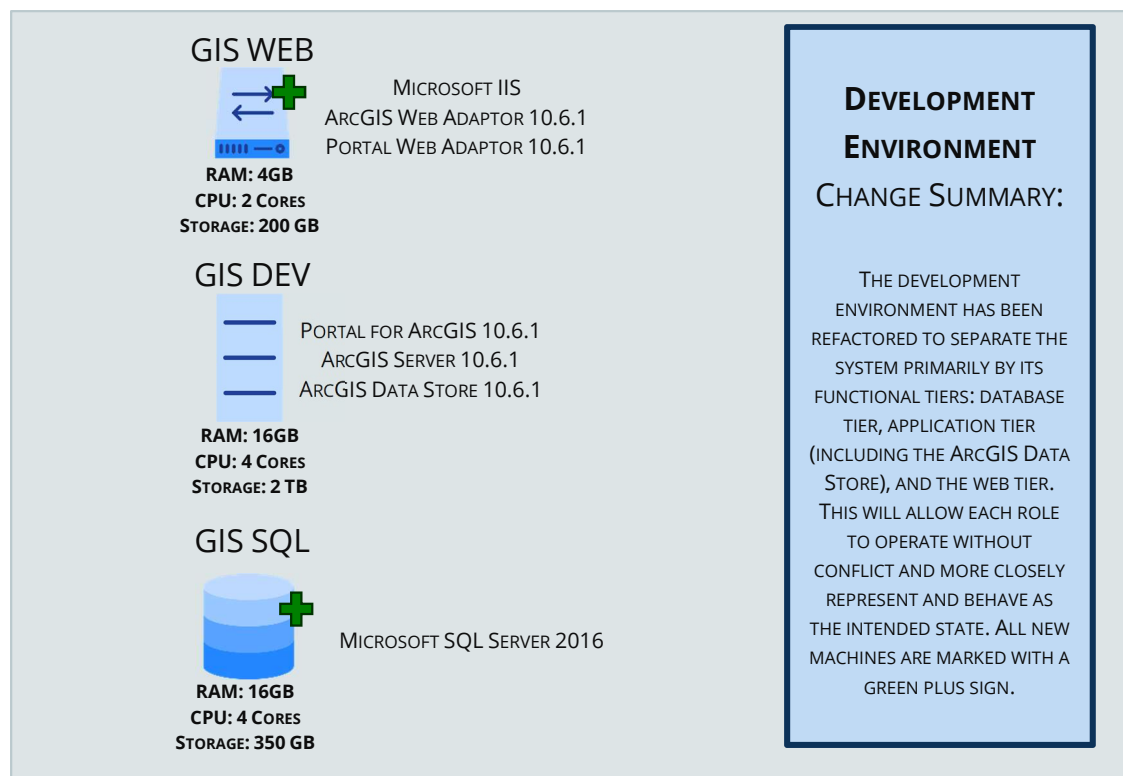
Technology Architecture: Recommendations

To best serve its staff and residents, GTG recommends that the City of Irvine invests in developing a more robust staging (testing) environment and potentially a more robust development environment. Additionally, GTG recommends that an application-tier failover system be deployed offsite to provide greater stability and reliability of the system in the event of an emergency. Finally, GTG recommends that all systems are regularly updated to the most recent patch release of the ArcGIS Enterprise platform.

Additionally, the current staging environment is logically inequivalent from the production environment, meaning that promoting a change from staging to production may result in unknown results. In its current implementation, the staging environment does not provide an adequate representation of how a change, service or application will perform in the production environment. A GIS staging environment that mirrors the associated production environment adheres to established IT and GIS best practices and will enable accurate load and performance tests to be performed thus ensuring the application and infrastructure will be performant under peak system loads in production. If sufficient resources are available, GTG recommends the staging environment be modified to mirror the production environment.

The recommended implementation of the staging and development environments are shown below.

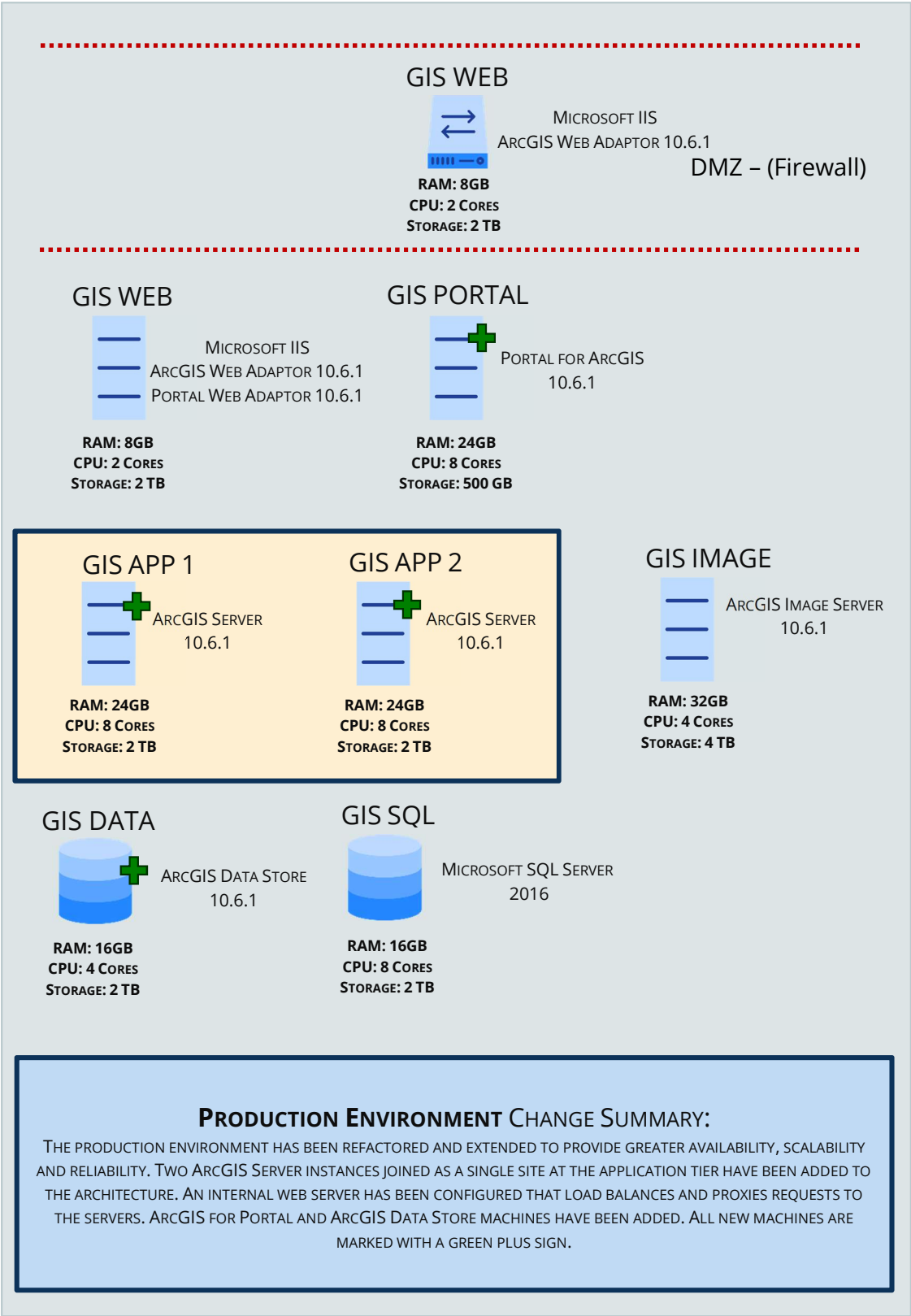




GTG recommends that the production environment be refactored to more effectively isolate the various system roles. Organizing the environment in such a manner provides greater stability, improved performance, and a greater capacity to implement changes and upgrades. The recommendations are intended to make the organization's GIS more performant, more change-tolerant, and more extensible for future improvements, additions or role-modifications.

In addition to refactoring the existing architecture, GTG also recommends deploying a second ArcGIS Server to the existing GIS site to provide greater availability, to reduce downtime, and to allow for easier management and administrative of the external production environment.

The **recommended production environment architecture** is shown on the next page.



It is also recommended that the City of Irvine adopt a formal ArcGIS upgrade cadence for **existing infrastructure** to provide the latest version of the software suite that is stable and available.

Network Communications Review and Recommendations

The City currently has a robust Local Area Network (LAN) and fiber Wide Area Network (WAN) in use. Desktop workstations receiving 1GB LAN connections and facilities receiving a minimum of 10GB/s network speed, will experience excellent performance from the GIS. This information, coupled with the experiences shared during the interviews and conversations with the staff of Irvine, indicates that the current network communications infrastructure is sufficient to support existing GIS use now and in the forecasted future.

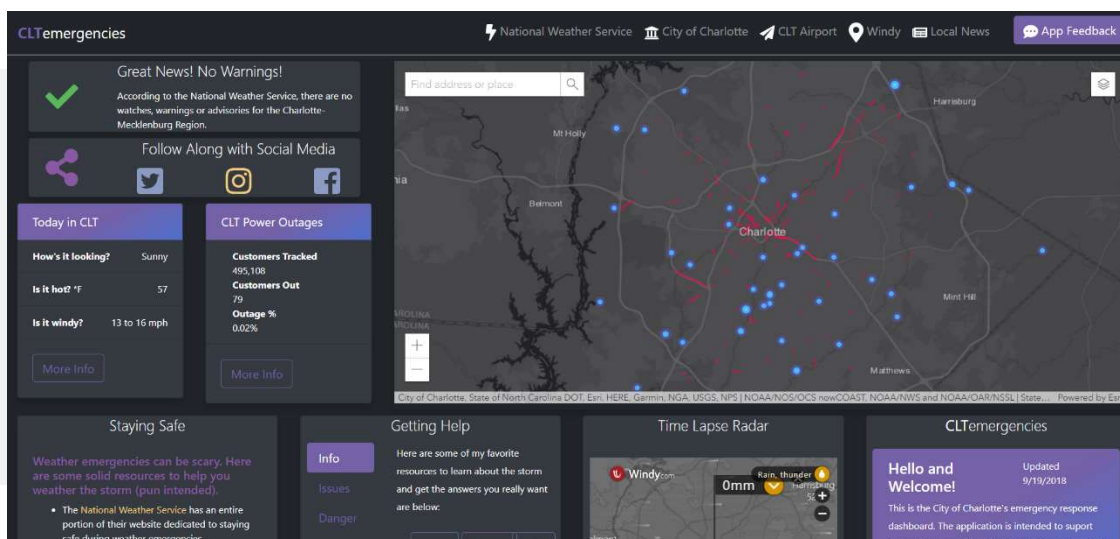
GTG recommends that Irvine support high-quality LAN and WAN connections as it pertains to GIS operations. In the case that Irvine develops interest in deploying a real-time, big-data platform such as Esri's GeoEvent Server Extension (GEE), we recommend that the City perform load and network capacity tests against high velocity, high volume, and high variety data streams.

GIS Availability/Stability/Uptime

Emergency Event Response

The City of Irvine's Office of Emergency Management currently has a robust process for planning for, responding to, and reflecting upon local emergencies. The Emergency Management department has established procedures, chains-of-command and technological solutions to effectively manage emergency and disaster events. These activities can be further enhanced through the use of GIS data, GIS methods and GIS technologies.

Esri's out-of-the-box (OOTB) resources allow for rapid proto-typing and deployment of emergency management applications, such as the Incident Status Dashboard, the Community Resilience Dashboard, and the Crowdsource Report Web Application. These OOTB technologies allow for low-investment/high-value solutions that can streamline the City's ability to respond to ongoing emergencies. These OOTB solutions can also be extended through the use of Esri's SDKs and APIs to provide greater functionality and a more integrated product to support residents.



In addition to these technologies, Esri also provides emergency product licensing that allows an organization to leverage the entirety of Esri's technological suite without limitations during emergencies. This program is known as the Disaster Response Program and you can access information through [Esri's website](#) or by engaging with your account manager.

GTG recommends an exploratory evaluation of Esri's OOTB emergency management offerings and an engagement with internal GIS resources to evaluate the feasibility of deploying these given the organization's current resources. In the event that GIS staff capacity to manage these efforts is limited, GTG recommends engaging with your Esri account manager to explore the Esri Disaster Response Program and engaging with a reputable GIS services vendor to augment the City's GIS resources.

24/7 Response

Irvine maintains helpdesk assistance enterprise wide from 6am to 6pm daily with 24/7 responsiveness for Public Safety and emergencies. To formalize this support, GTG recommends establishing service level commitments/agreements to define organizational responsibilities, expectations and procedures to provide necessary support to the organization. These service level commitments/agreements should include GIS infrastructure and software support to ensure the GIS is supported as intended.

Database Considerations

Currently, the City of Irvine leverages Microsoft SQL Server as the enterprise relational database management system and uses eVault/Carbonite as the backup management software. Backing up to an off-site data center is best practice and is in line with GTG's best practice recommendation. However, conversations with IT suggested that no formal disaster recovery or high-availability standards or governance documents are established, which exposes the City to potential mismanagement and/or incidental data loss.

The City has formally identified disaster recovery as a focus area for expansion in the 2018-2023 Strategic Technology Plan. GTG recommends formalizing the disaster recovery process and defining organizational service level commitments/agreements for recovery time objectives (RTOs) and recovery point objectives (RPOs). Formalizing these procedures will

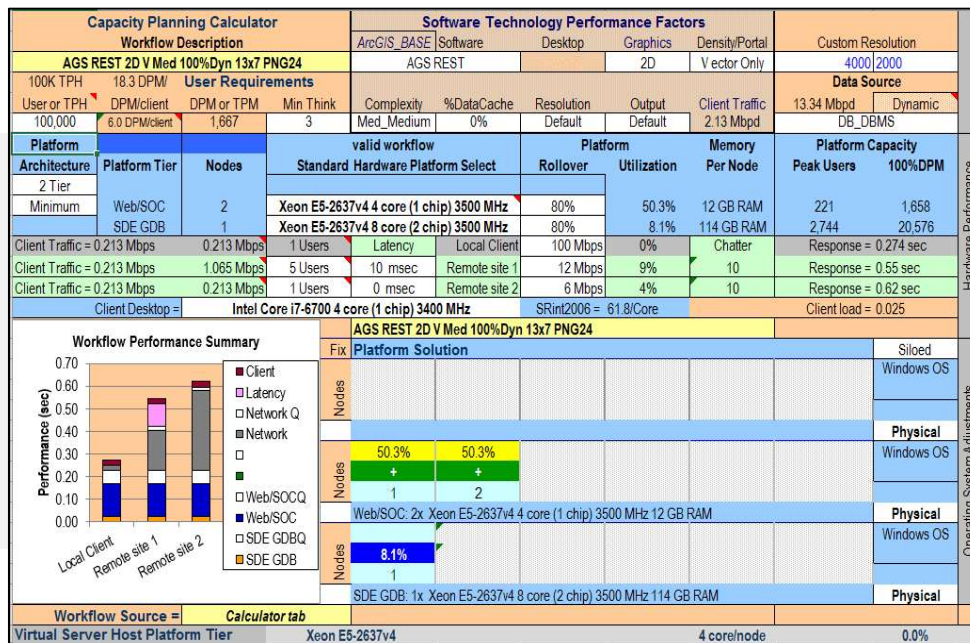
allow the organization to continually develop its disaster recovery and high-availability programs with clear objectives and metrics established. GTG also recommends investigating the organization's capacity for on-site or cloud-based redundancy.

System Architecture Design

The recommended system architecture for the City of Irvine was informed by the information gathered during GTG's interviews, results of Esri's Capacity Planning Tool (CPT) analysis, and from the collective expertise of the GTG GIS Enterprise Team. This section details the process and results of the system architecture design process. The below results have been synthesized and translated into recommendations for Irvine.

Platform Sizing

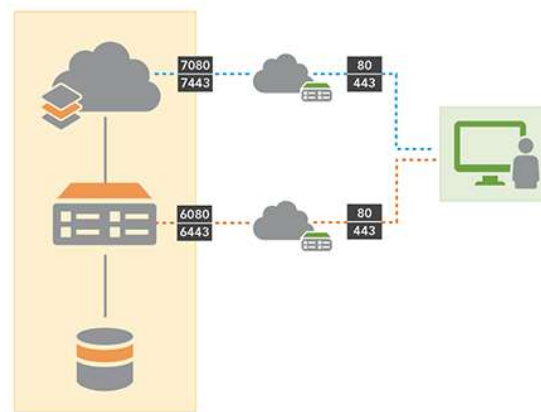
Identifying the right size, scope, and physical composition of a GIS is a function of several variables and conditions, including: the current and future organization's GIS community size; the existing and planned GIS workflows; the organization's existing IT infrastructure and hardware; the organization's structure and policies; the organization's vision for GIS; and the organization's capacity to sustain its enterprise GIS. Esri's CPT allows for consolidated analysis using these factors and executes meaningful analysis relating to the architectural needs of an organization.



The results of the CPT analysis are synthesized with GTG’s findings during the planning and evaluating phases of the project. Together, these inputs are used to scaffold a recommendation for Irvine. This scaffold is then evaluated against GTG’s experience and technical expertise to create the best-fit customized design to fulfill Irvine’s current and forecasted needs.

Server and Software Performance

In an enterprise GIS deployment, GIS data and methods are exposed as consumable services. Leveraging a service-oriented architecture (SOA) provides practical, administrative and performance benefits compared to a traditional local consumption model. In the ArcGIS Enterprise ecosystem, servers act as specialized components that allow for distributed and optimized GIS workflows and analysis.



Organizing an enterprise GIS within a SOA establishes four functional tiers of the system: the database tier, the application tier, the web tier, and the client tier. The database tier is built around an enterprise geodatabase that serves as the main data storage repository for spatial data. The application tier relates to the applications that expose the GIS resources as consumable and interactive services. Within the Esri paradigm, this is typically comprised of a Portal for ArcGIS application and an ArcGIS Server application. The web tier provides a means to access the GIS services through a web-server, allowing for their controlled consumption. The client tier refers to users and applications that consume the exposed web services.

This paradigm is highly scalable, highly performant and industry best practice. This paradigm can be further optimized by following Esri’s establish best practices which are made publicly available through their documentation and support sites.

Configuration Recommendations

For the City of Irvine to fully leverage the available functionality of the Esri suite it is imperative that the system's components are configured and related to each other in such a way that enables performant GIS analysis, simplified administration, and horizontal scalability. These goals can be achieved through the implementation of an enterprise Web GIS centered around Portal for ArcGIS and ArcGIS Server sites.

For Irvine, GTG recommends the implementation of a federated ArcGIS Enterprise deployment. In production, this should take the form of a multi-machine, single site ArcGIS Server deployment federated to a Portal site with network traffic traveling through Esri's Web Adaptor at the web tier to serve as both a reverse proxy and a load balancer.

In this implementation, GTG recommends a structured approach to service management and web content generation to prevent overwhelming the server through redundant/unnecessary service creation. As a general rule, your deployment should have no more than ten (10) map service instances running per CPU core on the ArcGIS for Server machine. An ArcGIS Enterprise site should have no more than two hundred service instances per site. This is to prevent encountering an operating system level limitation. GTG strongly recommends following these parameters.

*GTG recommends
the implementation
of a federated
ArcGIS Enterprise
deployment*

Centralizing the user-management and service-generation processes allows for best practices to be followed and to efficiently maintain an inventory of GIS resources available. GTG strongly recommends implementing this application-tier level governance. While this may limit the organization's ability to quickly publish services, it will prevent the degeneration of the enterprise GIS, allow the enterprise GIS team to effectively manage its resources, and will consolidate the technical skillsets into the most appropriate group within the organization.

GTG also recommends a GIS community education program to onboard staff to ArcGIS Enterprise, show the potential of the system, and cover best-practices and the governance procedures. ArcGIS Enterprise is only one piece of Irvine's GIS and GTG strongly recommends defining the scope, intention, and governance procedures of the city's ArcGIS Online organization as well. ArcGIS Online can provide greater agility and performance for quick,

project-based, and temporary Web GIS deliverables while ArcGIS Enterprise can provide structured, organization-level, and long-term Web GIS functionality.

ArcGIS Enterprise, ArcGIS Online and ArcGIS Desktop should be considered complimentary components of the City's GIS implementation and their roles, purposes, and governance procedures should be clearly defined. The organization's usage of these technologies should reflect their respective roles in the organization.

GIS Data Administration

The utility of a GIS ultimately relies on the data; without accurate data, GIS analysis has little utility; without accessible and available data, an organization misses opportunities of data-driven value; without a strong data infrastructure, an organization's ability to run the requisite workflows is limited. Significant consideration must be dedicated to establishing an organization's data structures, technologies, and policies and Irvine is no different.

Enterprise Geodatabase

Esri's enterprise geodatabase model is the industry standard and core driver of GIS within an organization. The enterprise geodatabase extends the spatial functionality of an enterprise relational database and is typically deployed atop a Microsoft SQL Server instance, an Oracle database instance or another premier relational database management system (RDMS).

At the City of Irvine, the enterprise GIS is supported by a Microsoft SQL Server instance that has been configured for enterprise geodatabase functionality. This configuration is in line with both industry best practices and the needs of the City. The enterprise GIS provides gateways for desktop and web GIS users alike to query data, visualize geographic phenomena and run geographic analysis against the datasets.

To support multi-user editing, the enterprise geodatabase supports both versioning and archiving workflows. Versioning is considered best practice and GTG recommends that the City continue to leverage versioning workflows in GIS data management processes. Versioning is enhanced through the process of replication, which allows for the synchronization of data across environments. GTG recommends that the City explore opportunities to leverage replication to further develop these processes.

GTG recommends that regular and structured procedures be established to maintain optimal database performances, such as rebuilding statistics, rebuilding indexes, database compression, and regular load-testing. These processes coupled with thoughtful table and data design can vastly improve database performance.

GTG also recommends that the City of Irvine use role-based security at the database level to both simplify and more tightly secure their data resources. This security model should be derived from the organization's identity provider (IDP), which is Windows Active Directory (AD). Leveraging the existing user and group-stores of the City's AD will allow for unified identity management, greater security, and a better use of the existing IT resources in place as opposed to managing built-in users or managing permissions at the user level.

Local Government Information Model

Esri has developed a data model that is intended to support and meet the complete needs of a US local government. This data model is known as the Local Government Information Model (LGIM) and is a regularly maintained established data model within the local government space. The LGIM is regularly integrated into Esri's downstream application templates and Esri regularly publishes workflows and best-practices for maintaining the LGIM publicly.

The LGIM contains a variety of logically defined feature datasets and feature classes that are common to most local government's spatial data needs. The LGIM connects silos of information in an organization and integrates processes across typical government departments. It helps provide for more effective operations, better communication, saves time and money, and engages citizens in more meaningful ways. In addition, it also supports data sharing between local governments and regional, state, and federal agencies.

The LGIM can also be extended and customized to meet the particular needs of an organization. This extensibility makes the LGIM a powerful framework for an organization to develop with and into. As Irvine continues to grow and develop, GTG recommends that the City evaluate the LGIM as a potential solution for managing its enterprise data resources.

File and Imagery Storage

The modern data center typically relies on the Storage Area Network (SAN) for its enterprise storage needs. The SAN is a high-speed network of storage devices that also connects those

storage devices with servers. It provides block-level storage that can be accessed by the applications running on any networked servers.

SANs typically use high speed fiber for connectivity resulting in the elimination of data transmission bottlenecks. Also, because SANs usually offer multiple connections to and from the data center's servers, they also improve availability. In addition, separating the storage from the servers frees up the computing resources on the servers for other tasks not related to storage.

SANs are particularly helpful in backup and disaster recovery settings. Within a SAN, data can be transferred from one storage device to another without interacting with a server. This speeds up the backup process and eliminates the need to use server CPU cycles for backup.

The SAN is comprised of any number of hard disk drives (HDD) or solid-state drives (SSD) that are typically in a RAID configuration. RAID is a technology for striping data across multiple drives to improve data redundancy or performance or sometimes both. The type of RAID configuration selected is an important consideration when looking at the GIS system architecture.

The most common RAID configuration used with enterprise GIS for data storage is RAID 5 which offers the following capabilities:

- **Consists of block level striping with distributed parity;**
- **If one disk fails, the parity bit on the parity disk can be used to restore the missing data;**
- **Provides optimum disk utilization and near optimum performance.**

SAN can be used both as storage option for SQL Server's data file, index tables, and log files and as a storage solution for organizational documentation, images, and/or installation files. It is recommended that the organization leverage SAN storage for its SQL Server implementations rather than using local storage for its benefits of stability, limited performance consequences, and its ability to be expanded. Developing databases on the local hard drive is not best practice and can result in the machine's disk reaching capacity, potentially resulting in data loss, corruption or failure.

Imagery can optionally be stored on SAN, however, often the format of the imagery and total size of the data can make storing imagery cost-prohibitive. Instead, Network Attached

Storage (NAS) is often used to store raw imagery. As opposed to SAN storage, NAS consists of a single device that is attached to the network and is accessible via network connections. NAS is less scalable and offers generally lower throughput, resulting in a performance hit. However, these performance limitations can be overcome by improvements in network capacity.

While NAS is less scalable and is generally less performant than SAN, it is relatively inexpensive, making it a viable option for organizations. NAS also leverages RAID technology but is limited to a single device rather than being distributed across several devices. When imagery is stored on NAS, consideration should be given to how the data will be leveraged. Often, it is more efficient to publish a cached map service to ArcGIS Enterprise and consume the optimized imagery as a service.

GTG recommends that imagery being consumed as a basemap or a contextual layer be published as a cached map service to ArcGIS Enterprise. Caching your imagery provides performance and storage benefits and is industry best practice. If the imagery is being used for raster, spectral, or delta analysis, GTG recommends that the imagery be added into a mosaic dataset for performance and storage optimization with the GIS ecosystem.

Non-Spatial GIS Data

While the GIS is ultimately powered by the spatial data used for visualization, analysis, and reporting, non-spatial data is often critical for providing context, additional information, and/or relational information. While it is out of GTG's scope to make recommendations beyond the organization's GIS and associated data integrations, we strongly recommend the City evaluate its non-spatial data dependencies both in the City's enterprise geodatabase and within other data stores.

Platform Performance

Technology, and GIS in particular, has changed dramatically over the past decade and the platform's ability to run intensive analysis, render data, and handle concurrent tasks have all improved tremendously. This change is perhaps most clearly demonstrated in GIS by the architectural changes Esri has implemented within its product line: ArcGIS Pro runs as a 64-

bit application, Esri has migrated to Python 3, and ArcGIS Enterprise now supports big-data streams and asynchronous operations.

Performance Baseline

The performance of computer hardware that supports GIS has increased dramatically over time. Platform per core performance is now 5.3 times faster than it was 10 years ago. The trend has been faster hardware and lower platform cost. For the purpose of measuring ArcGIS software performance, Esri has established a benchmark hardware system each year to identify the best available platform for GIS. Platform performance is measured using SPEC performance benchmarks.

The Standard Performance Evaluation Corporation (SPEC) was established in 1988 by a small number of workstation vendors for the purpose of creating an industry recognized realistic benchmark of computer hardware performance.

Esri specifically uses the "SPECrate_int2006" per core benchmark baseline for measuring hardware performance of various systems which is shown below.

	A	B	C	D	E	G	H	N	O	P	R
	Vendor (SPEC link)	System	# Cores	# Chips	# Cores/Chip	Processor	MHz	Baseline	Base/core	HW Avail	CPU
1											
2	IBM Corporation	IBM Power E880 (4.35 GHz, 64 core, RHEL)	64	8	8	POWER8	4359	4170	65.2	Nov-14	POWE
3	IBM Corporation	IBM Power E890 (4.35 GHz, 64 core)	64	8	8	POWER8	4359	4130	64.5	Nov-14	POWE
4	IBM Corporation	IBM Power E870 (4.19 GHz, 80 core)	80	8	10	POWER8	4192	4830	60.4	Nov-14	POWE
5	Hewlett-Packard Comp	ProLiant BL460c Gen9 (3.50 GHz, Intel Xeon E5-2637 v3)	8	2	4	Intel Xeon E5-2637 v3	3500	459	57.4	Sep-14	Inte
6	Cisco Systems	Cisco UCS B200 M4 (Intel Xeon E5-2637 v3 @ 3.50GHz)	8	2	4	Intel Xeon E5-2637 v3	3500	457	57.1	Sep-14	Inte
7	Dell Inc.	PowerEdge T630 (Intel Xeon E5-2637 v3, 3.50 GHz)	8	2	4	Intel Xeon E5-2637 v3	3500	457	57.1	Sep-14	Inte
8	Hewlett-Packard Comp	ProLiant DL380 Gen9 (3.50 GHz, Intel Xeon E5-2637 v3)	8	2	4	Intel Xeon E5-2637 v3	3500	457	57.1	Sep-14	Inte
9	Cisco Systems	Cisco UCS C240 M4 (Intel Xeon E5-2637 v3 @ 3.50GHz)	8	2	4	Intel Xeon E5-2637 v3	3500	456	57.0	Sep-14	Inte
10	Dell Inc.	PowerEdge M630 (Intel Xeon E5-2637 v3, 3.50 GHz)	8	2	4	Intel Xeon E5-2637 v3	3500	456	57.0	Dec-14	Inte
11	NEC Corporation	Express5800/GT110g-S (Intel Core i3-4350)	2	1	2	Intel Core i3-4350	3600	114	57.0	Jul-14	Inte
12	NEC Corporation	Express5800/T110g-E (Intel Core i3-4350)	2	1	2	Intel Core i3-4350	3600	114	57.0	Jul-14	Inte
13	Dell Inc.	PowerEdge FC630 (Intel Xeon E5-2637 v3, 3.50 GHz)	8	2	4	Intel Xeon E5-2637 v3	3500	455	56.9	Dec-14	Inte
14	Dell Inc.	PowerEdge R630 (Intel Xeon E5-2637 v3, 3.50 GHz)	8	2	4	Intel Xeon E5-2637 v3	3500	455	56.9	Sep-14	Inte
15	Dell Inc.	PowerEdge R730 (Intel Xeon E5-2637 v3, 3.50 GHz)	8	2	4	Intel Xeon E5-2637 v3	3500	455	56.9	Sep-14	Inte
16	Hewlett-Packard Comp	ProLiant DL360 Gen9 (3.50 GHz, Intel Xeon E5-2637 v3)	8	2	4	Intel Xeon E5-2637 v3	3500	453	56.6	Sep-14	Inte
17	Huawei	Huawei CH121 V3 (Intel Xeon E5-2637 v3)	8	2	4	Intel Xeon E5-2637 v3	3500	452	56.5	Sep-14	Inte
18	Huawei	Huawei CH222 V3 (Intel Xeon E5-2637 v3)	8	2	4	Intel Xeon E5-2637 v3	3500	452	56.5	Sep-14	Inte
19	Huawei	Huawei RH2288 V3 (Intel Xeon E5-2637 v3)	8	2	4	Intel Xeon E5-2637 v3	3500	452	56.5	Sep-14	Inte
20	NEC Corporation	Express5800/T110g-S (Intel Core i3-4350)	2	1	2	Intel Core i3-4350	3600	113	56.5	Jul-14	Inte
21	Sugon	Sugon I620-G20 (Intel Xeon E5-2637 v3)	8	2	4	Intel Xeon E5-2637 v3	3500	448	56.0	Sep-14	Inte
22	Cisco Systems	Cisco UCS C220 M4 (Intel Xeon E5-2643 v3 @ 3.40GHz)	12	2	6	Intel Xeon E5-2643 v3	3400	671	55.9	Sep-14	Inte
23	Dell Inc.	PowerEdge R730 (Intel Xeon E5-2643 v3, 3.40 GHz)	12	2	6	Intel Xeon E5-2643 v3	3400	669	55.8	Sep-14	Inte
24	Hewlett-Packard Comp	ProLiant BL460c Gen9 (3.40 GHz, Intel Xeon E5-2643 v3)	12	2	6	Intel Xeon E5-2643 v3	3400	669	55.8	Sep-14	Inte
25	Dell Inc.	PowerEdge R630 (Intel Xeon E5-2643 v3, 3.40 GHz)	12	2	6	Intel Xeon E5-2643 v3	3400	668	55.7	Sep-14	Inte
26	Dell Inc.	PowerEdge T630 (Intel Xeon E5-2643 v3, 3.40 GHz)	12	2	6	Intel Xeon E5-2643 v3	3400	668	55.7	Sep-14	Inte
27	Cisco Systems	Cisco UCS B200 M4 (Intel Xeon E5-2643 v3 @ 3.40GHz)	12	2	6	Intel Xeon E5-2643 v3	3400	667	55.6	Sep-14	Inte
28	Dell Inc.	PowerEdge M630 (Intel Xeon E5-2643 v3, 3.40 GHz)	12	2	6	Intel Xeon E5-2643 v3	3400	667	55.6	Dec-14	Inte
29	Fujitsu	PRIMERGY RX100 S8, Intel Core i3-4330, 3.50 GHz	2	1	2	Intel Core i3-4330	3500	111	55.5	Sep-13	Inte
30	Fujitsu	PRIMERGY RX1330 M1, Intel Core i3-4330, 3.50 GHz	2	1	2	Intel Core i3-4330	3500	111	55.5	Jul-14	Inte
31	Fujitsu	PRIMERGY TX1330 M1, Intel Core i3-4330, 3.50 GHz	2	1	2	Intel Core i3-4330	3500	111	55.5	Jul-14	Inte
32	Fujitsu	PRIMERGY TX140 S2, Intel Core i3-4330, 3.50 GHz	2	1	2	Intel Core i3-4330	3500	111	55.5	Sep-13	Inte
33	IBM Corporation	IBM System x3100 M5 (Intel Xeon E3-1281 v3, 3.70 GHz)	4	1	4	Intel Xeon E3-1281 v3	3700	222	55.5	Jun-14	Inte
34	IBM Corporation	IBM System x3250 M5 (Intel Core i3-4330, 3.50 GHz)	2	1	2	Intel Core i3-4330	3500	111	55.5	Dec-13	Inte
35	Intel Corporation	ASUS H97M-PLUS Motherboard (Intel Core i3-4360)	2	1	2	Intel Core i3-4360	3700	111	55.5	Jun-14	Inte

SPECrate_int2006 is a process intensive benchmark that stresses a system's processor, memory subsystem, and compiler and provides an accurate and consistent gauge of a system's performance.

The Esri CPT makes extensive use of the SPEC performance values to gauge how well an existing or potential hardware platform should perform. Using these performance values in conjunction with defined user workflows provides the CPT with necessary information to properly size a recommended hardware platform to meet the needs of an organization's enterprise GIS.

Platform Performance

The increasingly more powerful hardware platforms that have become available over time, have led to the development of a broad range of powerful software solutions. System processing capacity is important but system availability and scalability even more so for the support and optimal performance of an enterprise GIS.

The processors at the heart of most desktops and servers in use today are Intel based with desktop workstations and servers using the Intel Xeon line of processors. There are some AMD and Sun SPARC processors in use, but they only occupy a very small portion of the server technology segment. Intel Xeon processors have become the predominant Windows Server CPU. The Intel processors have steadily gained in performance while AMD processors have less than half the performance of Intel server class processors.

Faster processors reduce the processing time of a server or workstation and provide for increased system throughput. It is important to note that ArcGIS Server licensing is based on a per core licensing model (physical and virtual cores are treated the same). By deploying fewer and faster cores, ArcGIS Server licensing costs will be less with minimal loss of performance. Dual and Quad core configurations provide the highest per-core performance. Configurations with more cores, on the other hand, can support more virtual servers in a virtualized environment. The decision on which processor configuration to deploy will be based on cost versus required performance dictated by business requirements.

ArcGIS Server Platform Selection and Sizing

The City has an estimated potential build out over the next five years to 300 GIS users plus 1000 public access users (peak use assumption). Following are CPT results describing the

total optimal CPU and RAM resources needed in the production environment across all machines proposed. The results are based on projected user counts along with the recommended hardware solution. The CPT results provided are for a full build-out of the recommended infrastructure diagrammed earlier in this document. Based on the CPT System Design results and following industry best practices, the following server resources are recommended to support the City's GIS users in the City's production environment:

- **Database: 16 GB of RAM // 8 Cores – Per DB Server**
- **Application Tier: 72 GB of RAM // 16 Cores – Across Application Tier**
- **Web Tier: Normal Specs 8 GB RAM // 2 Cores – Per Web Server**

Software Solutions and Interoperability

Existing Applications

The City of Irvine has implemented a host of applications, some of which are GIS specific. Multiple software applications are used by various departments. The following list identifies software and applications in use by the City that are GIS related or contain data that are candidates for initial or further GIS integration.

- OnBase ECM (documents and records management)
- Eden (code enforcement), Progressive Solutions (business licensing)
- In Forum Gold (permitting)
- Central Square (finance)
- CivicRec (parks users)
- Lucity (asset management)
- Chameleon (animal control)
- Pavement management system
- Intergraph (CAD and RMS)

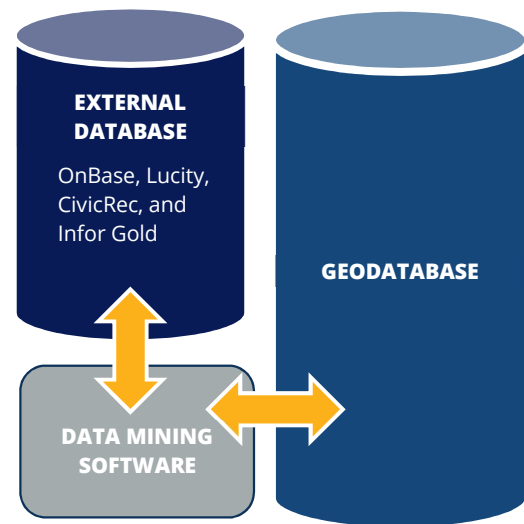
Software Solutions and Options

There are many different GIS software solutions and methods for implementation identified in the needs assessments, chapter of this plan. The recommended first steps to expand the suite of GIS software solutions available to City staff and residents is to continue the development of the enterprise GIS and to promote the usage of GIS technology to more staff in the City. The largest internal GIS user base will inevitably access the enterprise GIS via web GIS solutions. To accommodate this expansion of GIS usage and associated ROI, it is

recommended that the City focus efforts on developing and deploying targeted, departmental specific GIS intranet solutions. These departmental-based intranet portals will provide staff with the needed data, queries, and functionalities to complete a majority of needed daily GIS tasks, much of them by way of web enabled GIS accessed through standard browsers. An enterprise GIS leveraging a service-oriented architecture integrates an entire organization so that users can maintain, share and utilize spatial data for various needs to address data development, modification, and analysis. This will enable the City to share information within the organization and with the public much more effectively. The development of targeted intranet and internet GIS web applications coupled with GIS integration of non-spatial data (OnBase, Lucity, CivicRec, and others) and the development and deployment of mobile GIS software solutions will enable the City to capitalize on the potential ROI of the enterprise GIS. The following provides details related to these GIS needs.

Existing and Recommended GIS Integration with Business Systems

Integration with non-spatial data is a critical component of creating an enterprise GIS and a need expressed by several departments within the City. Data mining software tools can be used to extract data from existing databases by geocoding addresses or mapping coordinates and placing the results into a geodatabase. This process requires that a geo-referencing layer (e.g. address points, parcels, street centerlines) exist that the extracted data can be linked or geocoded with allowing it to be spatially enabled. The resulting data is then ready to be made accessible to GIS users, and analysts. The spatially enabled data



Data Mining Process

can be spatially analysed alongside other GIS data and presented in useful formats for data consumption such as maps, graphs or tables. Spatial views can also be created in the geodatabase that can display tabular data in a spatial context. Enterprise GIS desktop and web GIS software and tools can then be used to analyze the data and determine relationships. As the graphic above illustrates, data is extracted from an external non-spatial database, such as asset information in Lucity, and then imported into the City's enterprise

geodatabase. Irvine would follow a similar approach to integrate the data sources currently in use as seen below.

Several companies have developed application software, for example, FME by Safe Software that can overcome format and data model barriers to migrating data between data repositories so that the City can leverage the use of depicting data spatially. Some examples of existing applications/databases currently being used by the City that should be spatially linked include:

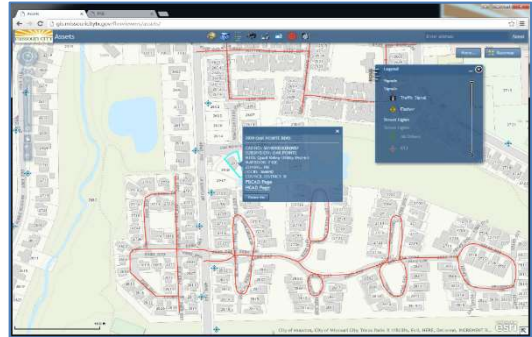
- **OnBase ECM (documents and records management)**
- **GoEnforce and Host Compliance (code enforcement)**
- **Progressive Solutions (business licensing)**
- **In Forum Gold (permitting)**
- **Central Square (finance)**
- **CivicRec (parks users)**
- **Lucity (asset management)**
- **Maintenance Connection (facilities work order system)**
- **LicenseTrack (Business Licences)**
- **Chameleon (animal control)**
- **Pavement management system**
- **Intergraph (CAD and RMS*)**

** The City is planning to migrate to Motorola Systems*

Most of the corporate IT databases should be spatially enabled for use in the City's GIS and used like any other GIS data. This will allow each department to view most pertinent data via one portal (GIS) and will result in a much larger return-on-investment (ROI) from these IT systems. Staff needs to make sure the IT systems store data with necessary characteristics (e.g. addresses or parcel numbers) in order to geo-enable this data. Recording data with these characteristics will allow it to be integrated into the GIS.

Web GIS (Intranet and Internet)

A recommendation for several departments in the departmental needs assessments was to have access to additional intranet and Internet web GIS applications tailored to departmental business needs for information. As of the time of this writing, Irvine has a developed and deployed 23 intranet web GIS applications and 8 internet web GIS applications. Following the service-oriented architecture approach, one of the City's primary



Departmental GIS Portal

continued GIS efforts should be to assess requirements for and deploy additional customized web GIS solutions. As the City's GIS program scales while implementing the recommendations in this plan, GIS staff should gather business need requirements and create these additional departmental or division-specific mapping applications with access to pertinent data needed by each respective department or division. Specific departmental data needs are included in the needs assessments. Intranet GIS applications should be the primary method for end-users to view and analyze GIS data and they should be designed to include needed analytical tools for staff. Existing GIS web apps should be assessed for opportunities to add additional value through the addition of widgets and searches for each user group. Unique queries, reports, and popups specific to user needs should be assessed, developed and deployed. These enterprise intranet applications provide a robust tool that allows specific configurations for departments while also providing the ability to share data.

Irvine should continue to utilize Esri's Web AppBuilder solution, as the GIS industry standard for COTS web GIS solution development. The Esri Web AppBuilder should be used to create both intranet solutions for each department/division and Internet portals for public GIS consumption. Enterprise GIS intranet applications built with Esri COTS solutions will reduce the amount of setup City-wide, require less refresher training, and will allow the City to leverage Esri's continued investment and expanded functionality of the ArcGIS platform. This will advance the use of customized intranet application usage throughout all departments/divisions. While there are third party GIS intranet browsers available as Commercial Off the Shelf (COTS) solutions, the robustness of the Esri Web AppBuilder

solution has allowed many organizations to forego the need for a third-party GIS intranet browser.

Multiple departments expressed the need for targeted public-facing Internet applications. Internet applications make sharing data with the public possible and allow employees to access, contribute, and collaborate while outside of the office. An example of a web GIS application requested during the Needs Assessments include a department-focused flexible application that could be expanded through the development of widgets and integration of third-party technologies like CivicRec, Lucity, and Eden. Another example is a Police staff request for an Operations Dashboard to see metrics about incidents. The goal is to allow Public Safety staff to have access to needed data to make better data-driven decisions in near real time improving service levels and creating efficiencies in staff time.

There are many web GIS possibilities to fulfill the need for internal and external consumption of GIS. It is recommended that the City of Irvine utilize a service-oriented architecture approach leveraging ArcGIS Online and various COTS Esri applications for intranet, Internet, and mobile solution needs.

ArcGIS Online

Through ArcGIS Online, organizations get access to Esri's secure cloud environment, where they can manage, create, store, and access data as published web layers, web maps, and web applications. ArcGIS Online is an integral part of the ArcGIS system, organizations can use it to extend the capabilities of ArcGIS Desktop, ArcGIS Enterprise, ArcGIS apps, ArcGIS Web APIs, and ArcGIS Runtime SDKs. ArcGIS Online is also a great solution for organizing and distributing GIS resources. This provides users with a one-stop shop potential for all data, maps, apps, documents, and anything GIS related.

ArcGIS Online implementation is a three-step process including planning, design, and deployment. Planning of agency logistics needs to be done carefully, with an understanding of how multiple departments will work together within ArcGIS Online. Careful planning for GIS



data incorporation, groups, users, and applications will all need to be considered. The development process of ArcGIS Online begins with the configuration of general settings, and then branches into setting up groups, web maps, the gallery, and much more.

In addition to basic GIS maps, staff need to utilize configurable tools that can assist them to increase efficiencies in staff time and enable better data-driven decision making. Customizable Web AppBuilder applications, Operations Dashboards, Story Maps and more will provide staff with a battery of situational awareness that is customized to their needs and allow better data-driven decision making. Irvine has already begun using some of these solutions, though the City should focus energy on ensuring these solutions fit within the vision and goals of the Enterprise GIS and that staff GIS requirements are being met.

The ArcGIS Online platform also provides ready to configure and deploy mobile GIS applications. These applications, including Collector for ArcGIS, and Survey123, provide a powerful way to utilize GIS and should be configured to meet field collection needs during the deployment process. The needs assessment identified a requirement for Public Safety departments to have a mobile GIS solution for emergency responders to collect and update incident and damage assessment information in real time for EOC operations. By leveraging ArcGIS Online, staff can choose how to deploy maps and applications for management, office staff, and field operations to reduce the need for printed maps and extend the use of GIS throughout the organization.



Collector for ArcGIS

Mobile applications for iOS, Android, and Windows are available to download and configure (see ArcGIS Solutions section below). For example, ArcGIS for Android or iOS can quickly be

deployed to tablets and smartphones to display and navigate maps, find addresses, identify GIS features, measure, find and share maps from ArcGIS Online, and collect data. The application can use either map layers hosted on ArcGIS Online or from the organization's ArcGIS Server.

Portal for ArcGIS

Portal for ArcGIS provides a user-friendly web interface for GIS users to create maps/apps, discover and share content, and consume GIS services. Portal for ArcGIS acts as the user-facing web “client” for an on-premise enterprise GIS deployment. Often Portal for ArcGIS is considered to akin to an “on premise ArcGIS Online.”

Portal for ArcGIS allows an organization to manage its enterprise GIS resources, users and services easily and provides significant administrative functionality that ArcGIS Online does not. Portal for ArcGIS is considered a necessary component of Esri's “Web GIS” implementation.

Portal for ArcGIS is most commonly deployed in conjunction with at least one ArcGIS Server site in a federation pattern. Federation is the process of integrating the security and sharing models of the portal with one or more ArcGIS Server sites. Federation is optional but is generally understood as required to realize the potential of the entire ArcGIS Enterprise suite. Federation is required for:

- **Security Assertion Markup Language (SAML) Configuration;**
- **Hosting Layers and Content; and**
- **Spatial Analysis within Portal for ArcGIS**

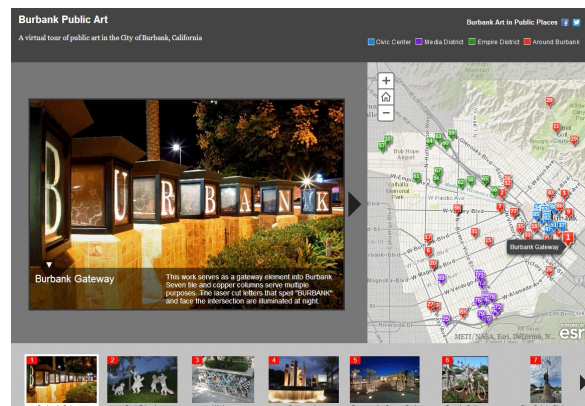
ArcGIS for Portal is a powerful application but may not be the best solution for every organization. Organizations which are already vested in ArcGIS Online may not see the need to have a redundant set of features available strictly on their intranet but instead, use ArcGIS Online for both external and internal mapping needs. While ArcGIS for Portal can serve data

out to the public, as well as staff outside the firewall just as ArcGIS Online can, ArcGIS for Portal may ease potential staff concerns over using browser-based access to data, maps, and applications for more sensitive data (Police, Fire, Utility Billing as examples) that are never stored or released outside of the City's firewall. Following are a set of criteria provided by Esri for implementing ArcGIS for Portal in addition to or in lieu of ArcGIS Online:

- **Organization requires full control over the hardware running the portal to maintain a particular service-level agreement (SLA)**
- **Organization requires service publishing from the website, and enterprise data is prohibited from being physically stored off-premises**
- **Computers in the organization are not connected to the Internet or have an unreliable Internet connection**
- **Organization wants to use functionality available only with Portal for ArcGIS and ArcGIS Pro, such as publishing their own 3D scene layers**

Story Maps

Esri offers the ability to create Story Maps which are an excellent platform for public facing conveying a City's story with data and maps. These web-based Story Maps tell a unique story in a very intuitive and user-friendly context. Story Maps will allow the City of Irvine to present and organize information geographically about places, events, issues, trends, or patterns. Story Maps offer an interactive map with rich content including text, videos, and audio to enhance the user's experience. For the City of Irvine, Story Maps will be an excellent way to display information related to cultural attractions, strategic planning efforts, capital improvement projects, special events, parks and trails, economic development, available properties and much more. Story maps lend themselves to presenting information that is cross-departmental such as city events and capital



Public Art in Burbank, CA

improvement projects. Story Maps can also be a vehicle to replace traditional one-size-fits-all public-facing Internet applications.

The City currently has several Story Maps including:

- **Community Services**
 - Child Care Facilities (In development)
- **Community Development**
 - Notable Development (Live)
 - Affordable Housing (In Development)
- **Public Works**
 - CIP Story Map (In Development)

Below is a list of the Story Maps requested by departments in the during the Needs Assessment interviews:

- **Community Development**
 - Home Ownership Associations (HOAs)
 - The Current General Plan for Irvine
- **Great Park**
 - Virtual tour of Great Park to include:
 - Navigation
 - Way finding
 - All facilities
 - Reservable facilities
 - Schedules

- 3D view of buildings and stadium
- **Public Works**
 - **Irvine Green**
 - Food waste prevention
 - Recycling facilities
 - Solar feasibility
 - Green cover
- **Transportation**
 - **Key plans**
 - ETA, SCAG, OCA, Regional Bike Plans
- **Public Safety**
 - **Internal Story Map for Crime Briefings**
 - **Meet the Officer Story Map**
 - **National Night Out Story Map**

ArcGIS Solutions

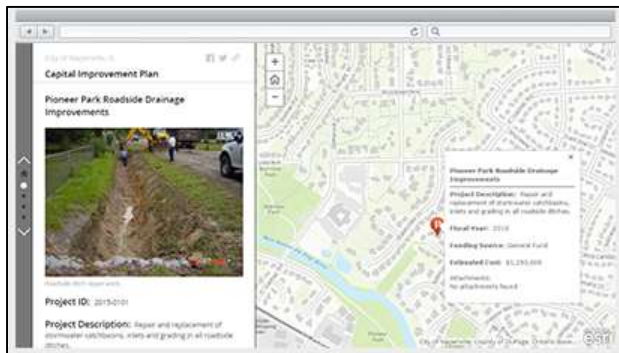
Additional COTS GIS solutions and applications are available through ArcGIS Solutions (<http://solutions.arcgis.com>) and the ArcGIS Marketplace (<http://marketplace.arcgis.com>). These applications are tailored for a variety of delivery methods including desktop, web, and mobile and are tightly coupled with ArcGIS Online. Hundreds of ready-to-use maps, apps, and platform configurations are available covering numerous categories including:

- Local Government;
- Emergency Management;
- Water;
- Telecommunications;
- Parks and Gardens;
- Among others.

Following are some example applications available from ArcGIS Solutions that could benefit the City of Irvine:

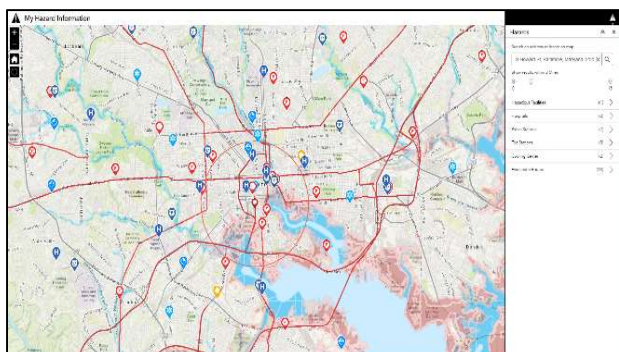
Capital Project Planning

Capital Project Planning is an ArcGIS configuration that can be used to coordinate capital projects, engage external agencies, and share capital improvement plans with the public. This application works in conjunction with the Capital Project Tracking application to provide a comprehensive capital projects solution including web maps and public-facing Story Map.



My Hazard Information

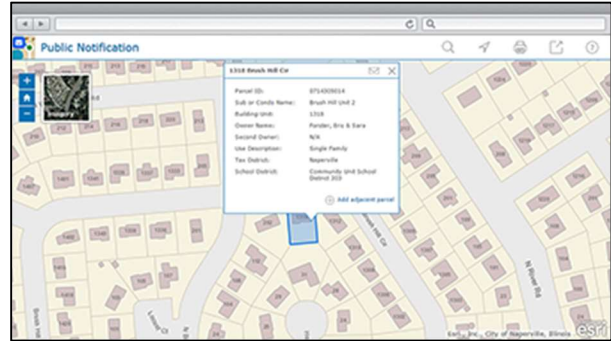
My Hazard Information is a configuration of the Esri Web AppBuilder for ArcGIS that helps residents discover hazards that exist in their community and obtain information about evacuation routes and government facilities provided by a government agency. This is a 24x7 application that supplements



customer service operations. The application can be used on a computer, table, or smartphone.

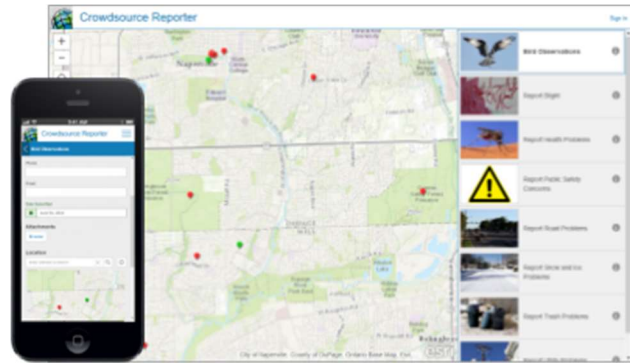
Public Notification

An application that allows staff to select a collection of properties and then create mailing label list of owners and occupants. The Public Notification is commonly used by any agency that needs to notify the public of any formal action being taken by the City. Mailing label widgets for the Esri Web AppBuilder can also be created and included in an intranet portal.



Crowdsource Reporter

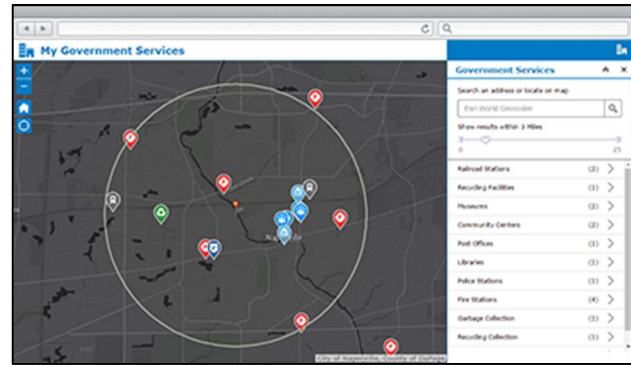
Crowdsource Reporter is a configurable application template that allows users to submit problems or observations. The application has been optimized for smartphones but is responsively designed to be used on smartphones, tablets, and desktop computers.



The Crowdsource Reporter application presents one or more maps that can be used to report a problem or observation. Users can anonymously submit new reports, review existing reports, and comment and vote on reports or observations submitted by other users. They also can authenticate with their social media or ArcGIS credentials and track the status of problems or observations they have reported.

My Government Services

A configuration of Web AppBuilder that can be used by the public to locate various public services available to the address provided. Includes the ability to get street directions to selected facilities. This is a 24x7 application that supplements customer service operations. The application can be used on a computer, tablet, or smartphone.



Above is just a small example of the numerous applications available from ArcGIS Solutions and the ArcGIS Marketplace that have the potential to benefit the City of Irvine.

Mobile

GTG recommends that the City draft and adopt a Mobile GIS Action Plan to gather specific mobile GIS requirements and to prioritize the development and deployment of City mobile GIS solutions. Several mobile GIS recommendations were provided in the needs assessments chapter that will enhance the City's mobile GIS capabilities (Parks Asset Inventory Collection, EOC Damage Assessment Collection). A City Mobile GIS Action Plan will ensure GIS staff efforts and developed mobile solutions will solve the right problems efficiently. Collector for ArcGIS provides robust and intuitive tools for viewing maps, collecting and updating data, getting driving directions, and tracking and reporting areas visited. Collector operates through ArcGIS Online or ArcGIS for Portal and provides the ability to work offline if network connectivity is not available. Collector is designed to work with iPhone and Android smartphones and tablets. ArcGIS Collector is the industry standard for deploying mobile GIS solutions that allow users from across an organization to leverage the power of mobile GIS. There are also opportunities for City of Irvine field staff to use Survey123, a form-based reporting Esri software in the field to take notes or record point data with a form-based data entry interface. Additionally, ArcGIS Online web maps are fully functional in the field through tablets or smartphones, however, these require a network connection to function. Web maps such as a GIS intranet portal can be used for viewing detailed information about assets in the field and allows field staff to locate a specific asset or area of interest and enter field notes. Documents and as-builts are also available for consumption in the field. These ArcGIS

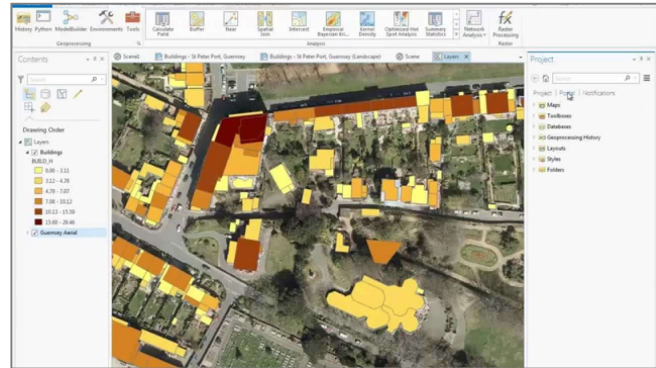


mobile GIS solutions also provide a series of configurable information pop-ups in which map-centric content can be visualized and used to update the status of work activities in the field. ArcGIS Online named users are required to sign in on mobile data collection applications and must be accounted for via the City's licensing agreement with Esri. Some of the departments that would benefit from Collector and/or Survey123 include:

- **Community Development**
- **Community Services**
- **Public Safety/CAD**
 - **Crime Analysis**
 - **Emergency Operations Center**
- **Public Works**
- **Transportation**

Desktop

The City of Irvine should continue utilizing ArcGIS Desktop as the primary tool for maintenance and Administration of GIS data. Esri also has a desktop product called ArcGIS Pro, a powerful, 64-bit desktop application that incorporates 3D mapping functionality without the requirement to acquire the 3D Analyst extension. Esri will continue supporting



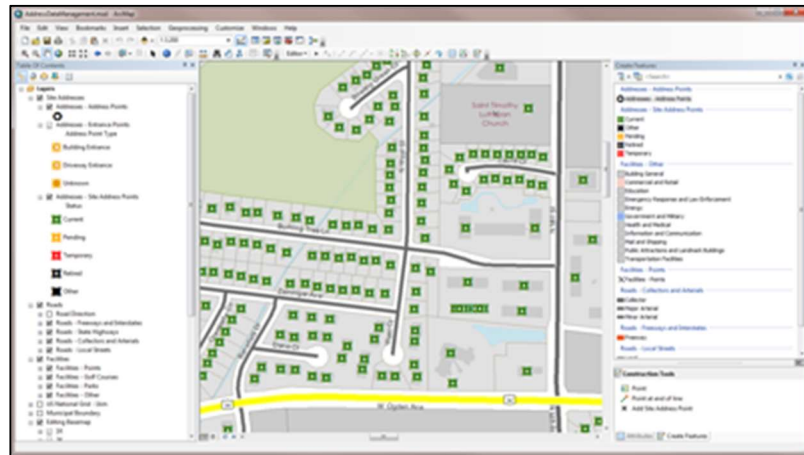
the legacy ArcGIS Desktop for the foreseeable future, but are focusing development and enhancement efforts on ArcGIS Pro. It is recommended that City GIS power users be provided an ArcGIS Pro license and training provided on using this software. Esri has provided some great resources to assist with getting started using ArcGIS Pro and is allocating resources to ease the transition from Desktop to Pro (<https://pro.arcgis.com/en/pro-app/>). It is recommended that the City develop a three-year ArcGIS Pro migration plan to transition remaining ArcGIS Desktop users to ArcGIS Pro over the next three years.

Additionally, there are several applications available for ArcGIS Desktop that can prove useful and are available through ArcGIS Solutions. Additionally there are tools available to allow specific applications to be developed without the need for complex coding. Not all of these solutions have been made available within ArcGIS Pro as of the completion of this document. In cases where these solutions are needed, ArcGIS Desktop should continue as the application of choice for those users. The following highlights some of these options.

Address Data Management

Address Data Management is an ArcGIS Desktop editing map and set of editing workflows for collecting and managing road centerlines with address ranges, facilities, site addresses, and related mailing address data. It is an editing map that can be used by mapping technicians to streamline the collection, maintenance and use of authoritative address information.

The editing map also includes two add-ins. The Address Management add-in and address construction tools contain a series of custom editing tools that improve the editing experience for ArcGIS users working with roads and address information. For example, there are tools that:



- Add new road segments and allocate existing address ranges to the new segments
- Flip road segments so the direction of the line and address ranges are in sync
- Add new site address points and compute the proposed address from a location along the road centerline

The second add-in is called the Attribute Assistant. This add-in is an editor extension that uses a series of pre-defined methods to automatically populate attributes when updating and/or adding new features to the geodatabase. For example, one method will populate the full road name on each road centerline and site address feature from a valid list of road names contained in a master street name table. Other methods will help maintain the integrity of your address data by populating a unique identifier, last editor and last update date on each feature.

ArcGIS Data Reviewer

ArcGIS Data Reviewer is an extension to ArcGIS Desktop that provides a set of quality control (QC) tools to simplify many aspects of automated and visual spatial data quality control. ArcGIS Data Reviewer offers over 40 out-of-the-box checks. The City can leverage these quality control checks to implement an efficient and consistent review process by automating spatial data quality control tasks. ArcGIS Data Reviewer checks may be run one at a time or can be grouped into a batch job. A batch job can also be scheduled to run once at a specific date and time or to run repeatedly at regular intervals.

Data Reviewer for Addresses is a pre-configured set of ArcGIS Data Reviewer batch jobs (.rbj) for performing quality control on site address and road centerline data. It enhances Address Data Management and is configured to work with the Local Government (LGIM) geodatabase described in the Data chapter of this document.

Extensions

The ArcGIS platform offers has a suite of extensions that extend the capabilities to the core product. The extensions offer a myriad of functionality and are grouped into categories including data analysis, data integration and editing, publishing, and cartography. The following is a list of recommended extensions (several the City currently has licensing for) the City should assess for value to the organization or expanded use:

- **ArcGIS 3D Analyst – (Irvine is currently using) Provides 3D visualization and analysis functionality in ArcGIS Desktop to view, manage, analyze, and share 3D GIS data.**
 - *Recommendation: Consider transitioning the City's 3D GIS workflows and needs to ArcGIS Pro.*
- **ArcGIS Network Analyst – (Irvine is currently using) Advanced routing and network analysis functionality.**
 - *Recommendation: Assess usage of the Network Analyst extension to identify additional applications and opportunities to create value.*
- **ArcGIS Spatial Analyst (Irvine is currently using) – Multiple tools allowing raster data modeling and analysis, including raster-vector data analysis.**
 - *Recommendation: Recommendation: Assess usage of the Spatial Analyst extension to identify additional applications and opportunities to create value.*
- **ArcGIS Workflow Manager – Create and manage GIS business processes as workflows in within GIS.**
 - *Recommendation: Assess the potential value of the Workflow Manager extension to identify potential applications.*

Summary of Existing and Desired GIS Software

Each department that was interviewed during the needs assessment utilizes GIS or GIS products or has expressed an interest in using GIS tools. Those that already access and utilize GIS expressed the desire to expand their use of the technology. Integration of non-spatial data, development of intranet applications, and the increased utility of mobile GIS tools were echoed by nearly every department throughout the City of Irvine.

Licensing Analysis

The City of Irvine currently acquires GIS licensing with Esri through a per-product licensing model. Software acquisition and maintenance licensing is one of the major costs for GIS. The City is currently paying Esri approximately \$40,000 annually for the per-product licensing. The following chart is a breakdown of the existing Esri licensing at the City:

Software	License Type	Number of Licenses
ArcGIS Desktop	Advanced Concurrent	12
ArcGIS Desktop	Basic Concurrent	9
ArcGIS Desktop	Basic Single-Use	4
ArcGIS Desktop 3D Analyst	Concurrent	4
ArcGIS Desktop Spatial Analyst	Concurrent	2
ArcGIS Desktop Network Analyst	Concurrent	1
ArcPad	General	2
ArcGIS Enterprise (Staging Server)	Standard (up to 4 cores)	1

ArcGIS Server (Staging Server)	Basic (up to 4 cores)	1
ArcGIS Server Enterprise	Standard (up to 4 cores)	2
ArcGIS Server Enterprise	Basic (up to 4 cores)	1
ArcGIS Developer Subscription	Developer	1

An alternate GIS licensing model for the City is to obtain GIS software through an Esri Enterprise Agreement (EA). With an EA, scheduled payments are made in exchange for a prescribed set of software, services, and training over the term of the agreement. An Esri EA will enable the City to scale the use of GIS through the organization without licensing constrictions and enable Irvine to better utilize its data as a resource to make improved data-driven decisions, improve customer service, and create efficiencies in staff time saving the District money.

The benefits of an EA include the following:

- **Readily available and uncapped access to ArcGIS software and licensing;**
- **ArcGIS Online Organization included for public facing GIS Solutions;**
- **Access to an included suite of valuable ArcGIS extensions and tools;**
- **Access to ArcGIS Commercial Off the Shelf and Configurable Web GIS Solutions;**
- **Ability to proliferate desktop, web, and mobile use of GIS throughout the organization;**
- **Deploy a Complete Development GIS environment with the included ArcGIS Developer Subscription;**
- **Discount on Instructor-led GIS Training;**
- **Includes Esri User Conference Passes;**

When assessing whether procuring an EA, important things to consider include:

- **Is the organization committed to scaling its GIS program and increasing ROI?**
- **Does the city have the capacity to implement and leverage the additional software?**
- **Is the necessary training to effectively implement and leverage the new GIS tools and solutions feasible?**

Esri has proven year after year that their customer base is of the utmost importance to them. This is evidenced by their constant software updates and improvements along with a high functioning support mechanism. Esri invests an extensive amount of resources each year into its software platform, ensuring end user experiences are continually updated and improved.

An EA provides readily available and uncapped access to ArcGIS software along with timely and expert assistance from Esri so that you can focus on building a successful and scalable enterprise GIS. Esri typically prices an EA based on the municipality's population. For exact pricing, coordinate with Irvine's Esri Account Manager to obtain a formal Esri quote.

The software typically included (coordinate with Esri representative to obtain official software info) in an EA is as follows (usually at uncapped amounts):

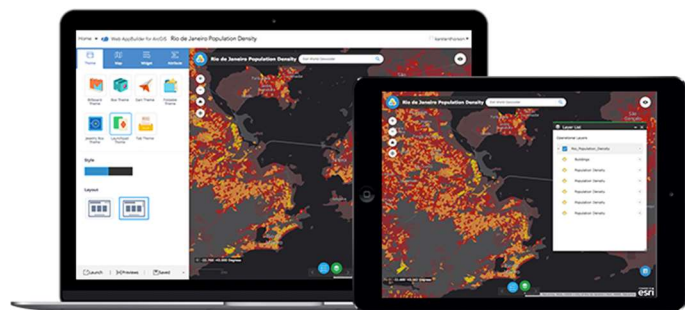
- **ArcGIS Desktop (Advanced, Standard, and Basic) – Single Use**
- **ArcGIS Desktop Extensions (3D Analyst, Spatial Analyst, Geostatistical Analyst, Publisher, Network Analyst, Schematics, Workflow Manager, and Data Reviewer) – Single Use**
- **ArcGIS Enterprise (Advanced and Standard) – Enterprise and Workgroup**
- **ArcGIS Enterprise Extensions (3D Analyst, Geostatistical Analyst, Workflow Manager, Network Analyst, Spatial Analyst)**
- **ArcGIS Enterprise Optional Server (Image Server)**
- **ArcGIS Engine**
- **ArcGIS Engine Extensions (3D Analyst, Spatial Analyst, Geodatabase Update, Network Analyst, and Schematics)**

- ArcGIS Runtime (Standard)
- ArcGIS Runtime Analysis Extension
- ArcGIS Developer Subscription (1 Professional Subscription)
- Esri CityEngine Advanced (2 Single Use Licenses)
- ArcGIS Online Named Users (100 Viewers, 100 Creators, 17,500 credits)
- ArcGIS Enterprise Named Users (100 Level 2)
- Insights for ArcGIS for use with ArcGIS Enterprise (5 users)
- Self-Paced e-Learning
- Instructor-led Training (percentage discount)
- User Conference Passes (three typically included)
- Authorized Support Callers (four typically included)
- Additional Authorized Support Callers (for an additional fee)

Final Software Considerations

Web Mapping Portals

This plan has recommended the extensive use of intranet and Internet web GIS applications as well as web-based tools. These applications and solutions will serve as data viewers that provide query and analytical capabilities. It is important that the City ensure these



solutions are all-inclusive and do not create data or information stovepipes. These solutions should be implemented with a true enterprise-wide mindset that will not only offer viewing and analytical capabilities but will allow the City to add a host of other tools via modules or widgets to solve enterprise challenges and problems. The City should strive to make all GIS

applications maintain continuity in the user interface/user experience and the database sources.

Such application deployments are achievable. For example, as described in the needs assessment, utilizing Esri's ArcGIS for Local Government (AG4LG) includes a host of resources that allow local governments to rapidly deploy GIS technologies. The City can immediately take advantage of tools for inspections, dashboards, capital projects, community planning, emergency management maps, and many others.

Other Considerations

Another critical consideration is the need to always involve the GIS Team when making an IT acquisition. Every enterprise software product should embrace the need to geo-enable the data that is captured in the system. Therefore, it is important to select tools that embrace this need. As the City chooses solutions, efforts should be made to ensure these new IT systems interact seamlessly with GIS to promote a true enterprise system. Often organizations err by involving the GIS team after the IT system has been acquired. This leads to inefficiencies and data/software stovepipes.

The City of Irvine is well positioned to quickly advance their GIS capabilities well beyond what has already been accomplished. By carefully considering and selecting the right software solutions and planning for deployment, the City will realize gains in efficiency, better decision making, cost savings, and increased customer service through expanded enterprise usage.

Organizational Readiness

City of Irvine | CA

Table of Contents

Executive Summary	2
Introduction - Governance Definitions and Concepts	5
GIS Technology Principles.....	5
History of GIS (Including Governance) at the City of Irvine	7
Current Organizational Structure and Best Practices	11
Industry Best Practices.....	11
Desired Outcomes	14
GIS Usage By Department	14
Current Staffing and GIS Usage	16
Current Irvine Governance Model	18
Gap Analysis.....	21
Recommended Actions	23
A GIS Steering Committee (Management Team) Should Direct the Enterprise-Wide GIS	23
Formal GIS Directives Should Be Adopted	26
Officialize Governance Strategy and Define Roles	27
GIS Communication and Education Strategy	37
Introduction.....	37
GIS Training.....	37
ArcGIS Training Recommendations.....	38
GIS Training Matrix	39
Training Classes - Tier 3.....	51
Multi-Year Training Plans.....	51
Additional Enterprise Training.....	54
Continued Growth and Education	55
Communication and Knowledge Transfer Plan.....	58
Communication Method	59
Succession Planning.....	64

Training, Education, and Knowledge Transfer Conclusion	64
Summary of Organizational Readiness Recommendations	65
Task 1: Create a GIS Steering Committee	65
Task 2: Officialize the GIS Governance Model	66
Task 3: Annually Update the GIS Strategic Plan	66
Task 4: Adopt a GIS Vision, Goals, and Objectives	66
Task 5: Formalize a GIS User’s Group	66
Task 6: GIS Policy and Mandates	66
Task 7: Measure the Quality of Service.....	67
Task 8: Identify GIS Authority and Clear Lines of Responsibility.....	67
Task 9: Develop an Annual Detailed GIS Work Plan	67
Task 10: Nurture a Culture of Collaboration Among Stakeholders	68
Task 11: Alignment with City’s Overall Vision, Goals, and Objectives (Resilience Strategy)	68
Task 12: Consider an Additional GIS Specialist.....	68
Task 13: Create an Annual Training Plan.....	68
Task 14: Create an Annual Communication Plan.....	69
Task 15: Create a Succession Plan	69
Task 16: Include Project Managers in the GIS Program.....	69
Appendix 1 - Enterprise-Wide Organizational Models	70

Executive Summary

A geographic information system (GIS) allows a local government to visualize, question, analyze, and interpret data to understand relationships, patterns, and trends. GIS has become a primary information management tool for local governments worldwide. The City of Irvine has been using GIS technology since the late 1980s. Over time the GIS has matured from sporadic project-based efforts to a pervasive tool used by many staff at the City. The City investment in GIS has been substantial over the past few decades and as such the GIS should be viewed as an enterprise-wide asset. Hundreds of very accurate and comprehensive data layers have been developed representing the needs of the organization. GIS is used for diverse needs such as managing growth, promoting a safe and sustainable community, and tracking infrastructure assets.

GIS has evolved at the City without any formal growth and management plan. The City's Chief Information Officer (CIO) and other City leaders recognized that the need for GIS is pervasive. Every department, every staff person, and the public have the need for geospatial (GIS) tools. GIS has become a core component to most of the City's Information Technology (IT) systems, making the need for a well-managed GIS program even more critical. To that end, the City decided to pursue a GIS Master Plan that will serve as the roadmap for further

GIS has become a core component to most of the City's Information Technology (IT) systems, making the need for a well-managed GIS program even more critical.

implementation of GIS technology, ensuring that the City's investment is managed effectively. Phase 1 of the plan included interviews with every City department to create a GIS Needs Assessment. This Assessment identified over 50 unmet needs, many of which are mission-critical to successful management of the City. This phase (Phase 2) of the project analyzed how best to move forward

with GIS in regards to technology, data management, mobility, public engagement,

governance, and education. This chapter examines the readiness of the organization in regards to GIS growth, governance, and educating the organization about the use and power of GIS.

Overall, the City is in a good position with regards to GIS Governance. Professional GIS staff from the CIO's Office are focused on providing GIS services to the organization. Additionally, various departments have GIS capable staff that act as GIS Power Users for their departments. Also, all staff and the public have been provisioned with end-user tools to view and analyze GIS data. However, GIS needs to continue to evolve and expand. It has the potential to become the primary data visualization and information portal for the city (internally and with residents). To that end, this chapter has a number of key recommendations to include:

- Optimizing governance so that GIS is fully utilized as a data dissemination platform;
- Create a GIS Advisory Committee that can champion and guide GIS priorities from year to year;
- Clarify roles and responsibilities of the GIS team and end-users;
- Ensure that a GIS User's Group becomes a priority;
- Extend the role of the Technical Project Managers in the CIO's office to consider GIS optimization and usage;
- Measure the quality of service and effectiveness of the GIS annually;
- Create and publish an annual GIS Work Plan;
- Ensure that GIS aligns with the City's overall vision, goals, and objectives to include an annual alignment report;
- Create an annual training, education, and communications plan;
- Ensure a proactive outward focus of the GIS Team.

The City of Irvine should not accept a mediocre GIS program. The CIO and the GIS Team are eager to implement the necessary tools, techniques, and changes to the program that will ensure that the City's geospatial (GIS) program is second to none. The implementation of the recommendations in this organizational readiness chapter is absolutely critical to the furtherance of the GIS program at the City. The City should strive to become a certified GIS Center of Excellence with GIS becoming a primary platform for all City decision-making (internally by staff and externally by the public).

Introduction - Governance Definitions and Concepts

Geographic Information Systems (GIS) technology provides a framework for organization-wide cooperation by using location as a common frame of reference, allowing individuals and departments to share information about locations. An enterprise GIS promotes interoperable technologies, standards, and methods, thus facilitating more efficient and effective use of technology. GIS should be considered a unifying technology that promotes organizational sustainability and empowers employees to view all pertinent data through one common platform. Additionally, GIS is a great tool for engaging and informing citizens thus promoting a sense of community. Coordinating efforts help organizations better use the capabilities of GIS technology and results in less staff time spent searching for, compiling, and integrating GIS data and the reduction of public frustration caused by being uninformed or working with disjointed local government departments.

GIS Technology Principles

GIS is unique within information technology because of the relatively high start-up costs (especially in regards to data), its spatial nature, its ability to unify disparate systems, and its ability to present very complex information in an understandable and usable context. Therefore, the challenges associated with governing a GIS are unique and require governance principles and rules, in addition to the information technology principles and specific local government principles.

A **GIS Governance Model** is an organizational structure and process that can facilitate GIS technology growth and use. Governance model implementation can be complex and problematic, but the right governance model is critical for effective technology diffusion. If the aim of implementing geospatial technologies is to improve organizational effectiveness and efficiency, then selecting a governance strategy is a critical key to success. The appropriate governance model is even more important when considering multi-departmental/shared GIS resources. **The number one reason that enterprise-wide GIS**

programs fail, or do not live up to their potential, is a poor or misaligned governance model.

The selection, therefore, and implementation of the right governance model could give rise to positive and beneficial characteristics. Alternatively, the selection and/or implementation of a poorly suited governance model can have negative consequences. The following table contrasts the results of good GIS governance against that of misguided GIS governance.

GOOD GIS GOVERNANCE RESULTS:	MISGUIDED OR LACK OF GIS GOVERNANCE RESULTS:
<ul style="list-style-type: none"> • Supports effective, strategic decision making • Organization-wide resource planning • Seeing GIS information as a public resource • Project and process management • Prioritized resource control • Clear lines of roles, responsibility, and accountability • Easy geographic information exchange • Timely response to internal and citizen GIS requests and questions • End-user participation • Stakeholder consent building • Increased productivity • Accurate information, map data, and statistical reports • Working as a team • Organizational sustainability 	<ul style="list-style-type: none"> • Assumption based decision making • Empire building • Misinformed public • Data and process duplication • Variations in priorities • Constant internal competition over funding projects and resources • Information hoarding or missing information • Inability to locate critical or timely information • Insensitivity to users' needs • Insufficient prevention and response • Inefficient decision making • Poor training and education • Poorly maintained, misplaced and stale information • Everyone going their own way • Poor organization performance

History of GIS (Including Governance) at the City of Irvine

The GIS function at Irvine dates to the late 1980s. GIS was first acquired by the Information Technologies (IT) Department. Software was acquired and supported by IT. A staff person in IT supported GIS. A GIS Supervisor position was eventually created to assist the city-wide GIS effort. The main departments using GIS at that time were IT, Community Development, and Public Works. The first GIS implementation plan was developed in 2003. The principal focus of that plan was to systematically move GIS to an enterprise-wide GIS. The plan was prepared jointly by ACS and ESRI (now Esri). The plan focused on data enhancement and data organization. At this time, GIS was moving away from a file-based structure to a standard RDBMS geodatabase approach. Because ACS (property/parcel software company) and ESRI (GIS software company) were the two creators of the plan, the plan focused more on the technology than it did on the overall platform (governance, technology, education). Over time, the City migrated from UNIX based file GIS to a Windows PC/SQL based GIS.

During the early 2000s, GIS use was expanding throughout the City. The Police Department began using GIS for 911 and crime mapping. At some point, the GIS function and management were moved to Community Development (CD). In 2014, the GIS team resided in the Building and Safety Division of CD. The vision for a GIS managed as an enterprise-wide platform was not in place and therefore GIS was functioning as independent stovepipes of somewhat uncoordinated use. Things changed in 2014. The City realized that GIS should be seen as a coordinated technology that needed centralized management. Therefore, the GIS team in CD was moved to the CIO's Office. The current GIS Supervisor was hired in 2014 and leads a team of 3 full-time and 3 part-time staff that support enterprise-wide GIS usage. No mandate or charter was created to govern the GIS team nor the enterprise-wide GIS



*The central GIS team
is serving all
departments as-
needed.*

effort. GIS use has grown significantly over the past few years as the GIS Supervisor has promoted GIS adoption within all departments. The central GIS team is serving all departments as-needed with many requests for assistance coming from CD, the City Manager's Office, Great Park, Public Works, and Transportation. The GIS team today operates by prioritizing requests as they come in and do not have an overall annual work plan. Key focuses of the central GIS team are;

provisioning GIS applications for users, maintaining the central database, enabling and assisting with data collection, increasing the use of GIS through-out the City, and updating GIS data layers. No plan exists for systematic training and education.

The following is a summary of full-time GIS staff and those staff that are power users in various departments:

- **Information Technology GIS Team (entire team is tasked with promoting GIS throughout the City)**
 - GIS Supervisor – main job function is oversight of the enterprise-wide GIS, increasing the use of GIS, (act as GIS evangelist) prioritizing work, and ensuring its completion
 - Two Senior GIS Analyst/Applications Specialists – lead GIS technologists focused on applications and the central geodatabase and integration of GIS with existing and new systems, (act as GIS evangelists)
 - GIS Analyst – supports departments on projects and maintains key datasets
 - GIS Technician – maintains key GIS data
 - GIS Intern – works on data and projects
- **Community Development**
 - Planner with a strong GIS background
- **Police Department**
 - Crime Analyst
 - Part-time GIS Analyst
- **Public Works**
 - Program Specialist – power user for the department
 - Intern – data entry

The GIS program has made strides since it has been moved to the CIO's Office. The central GIS team fields numerous requests for service and maintains the technology, some of the

data, and software necessary for the city-wide effort. However, there are big opportunities to continue to make GIS a primary decision-making platform for the City. Today, there is no organizational mandate to provide GIS training for the organization and its users. There is no formal relationship with a governing board for direction. This plan should become the driving document for moving the program from a set of technologies to a pervasive platform that is the primary visualization and decision-making platform for the City and residents.

From the management perspective, the Chief Information Officer (CIO) provides the overall vision and high-level guidance for GIS. The CIO position was created to lead the organization by spearheading innovation and leveraging technology to enable the organization to carry out their duties more effectively with additional insight into key data and metrics. The CIO is the liaison with the city leadership team. A 2019-2024 City of Irvine Strategic Technology Plan (STP) has been adopted to carry out the vision of innovation, insight, and exceptional services.



The CIO has instituted a management solution whereby Technical Project Managers (PMs) are empowered to work directly with and become experts on the needs of the departments. This allows the technologists (PMs) to focus on solutions instead of the technology. This is an important component of a move forward strategy for GIS at the City, as GIS should be seen as a primary decision making and information platform whereby all staff will be able to visualize their data geographically and make better and more informed decisions.

A variety of best practices are discussed in this chapter. One of those is education about GIS as a primary decision-making platform. This requires engagement with executives and end-users. Currently, the City has no executive steering committee to guide and prioritize GIS activities or to act as executive champions of the technology. Additionally, the City does not conduct formal user group meetings that serve as a conduit for promoting technology and educating the users. The CIO recognizes the enterprise-wide value of GIS and realizes the need to elevate GIS within the organization, thus this strategic plan. GIS is being recognized as an enterprise-wide program and actions are being considered to advance GIS throughout the organization (as a result of this plan).

In Irvine today, GIS is being governed as a technology and not as an enterprise-wide data dissemination platform. A technology is seen as hardware and software that can be purchased, loaded, and provided to staff much like a word processor or spreadsheet application or a GPS device. An enterprise-wide platform is considered an integrative corporate asset that requires a leader, a governance strategy, an education/communications strategy, and a host of other managed facets.

GIS is a multi-faceted program made up of many technologies. GIS should become the window into all of the other applications in which the City has invested. Irvine realizes this and wants to make GIS an integral part of City operations. At an enterprise-wide level, GIS becomes the conduit for centralized information and decision-making. It affects how each department does its job. It alters many long-standing processes. **A program that is this far-reaching requires a well-defined and officially adopted governance strategy. If it is seen as just another technology, then it will fail to achieve the desired results.**

Current Organizational Structure and Best Practices

Based on departmental interviews and information gathering, GTG has determined that the City currently has a GIS organizational structure with a mix of governance tendencies- **centralized and hybrid** (See Appendix 1 for Information on GIS Organizational Structures). The GIS Team (in the CIO's Office) (hereafter referred to as the GIS Team) has responsibility for GIS hardware, software, system architecture, and corporate spatial dataset management. Most departments and users come to the GIS Team for their GIS needs. Some departments have their own GIS power user.

When looking at cities across North America, a vast majority of enterprise-wide GIS implementations have a lead GIS staff person (GIS Coordinator, GIS Manager, or GIS Supervisor). Irvine has this critical position in place. Additionally, a number of best practices must be considered and are discussed below.

Industry Best Practices

GTG has interviewed and analyzed hundreds of cities in regards to their governance and best practices. From this extensive experience, GTG has identified best practices that lead to successful enterprise-wide GIS success. The following items are considered to be best governance practices that lead to GIS success:

- **Lead GIS Staff Person** – One of the most important components of a successful GIS is having a lead staff person, who has the primary responsibility of setting GIS priorities (based on user needs) and enabling GIS use and growth. Organizations without this lead GIS position flounder with GIS or use GIS as a niche product. Irvine has this position in place. The key elements of this position are described later in this document.
- **Steering Committee** – Many organizations are not governed by a steering committee. However, many of the most successful GIS implementations engage

executive-level staff in some components of GIS strategy and growth (often as a Steering Committee). It is important that Irvine consider a Steering Committee, at least for the next few years, as GIS is elevated as a primary information platform in the organization. Under the guidance of the CIO, the Steering Committee typically shapes the funding for and the direction and policy based on this GIS Plan.

- **GIS Organization** – In analyzing GIS growth and ability to permeate the enterprise, it was apparent from the interview process and analyzing successful GIS organizations that communities that have moved to a hybrid or centralized model of GIS governance have had the most success. These are the communities that have been able to provide GIS services as back-office support and applications. These same organizations have put the tools for some data development and maintenance into the hands of the departments that have the subject matter experts (SME) and expertise. This has helped these organizations with further integration of the GIS at the disparate database level, such as integrating with customer databases, asset databases, etc.
- **Awareness, Training, and Knowledge Transfer** – Successful implementations did a good job of making the user community aware of the GIS through various educational methods. A greater measure of success was also noted where communities were able to provide access to their departments and the public to the developed data. The most successful organizations provide extension training and education. One of the pillars of the most successful GIS implementations is a well-executed GIS training and education plan. This chapter dedicates a section to a training and education plan. Currently, Irvine does not have a formalized training and education plan.
- **Adoption of a standard GIS platform and centralized database** – Esri is currently the global standard-bearer for GIS software. Some organizations have a mix of GIS software, necessitating conversions and data that is time-consuming and results in delays in data. Additionally, a centralized GIS database where all GIS data is stored is imperative. Irvine has incorporated both of these variables.
- **Data maintenance and workflows** – A central data maintenance process and workflow is essential to ensuring optimal data sharing on an enterprise level. It also reduces data redundancy and ensures staff who access a central data warehouse have up-to-date data. Additionally, the most successful GIS

implementations spread data maintenance throughout the organization, ensuring that most departments are able to participate in the maintenance of data for which they are the data expert. The data chapter identified a number of recommendations in regards to the data efforts at the City.

- **Enablement** – The most successful organizations have enabled all departments and the public with meaningful and targeted applications. These applications are vetted and refined by working closely with the department. They bring in data from various systems and begin to act as the primary visualization and analytical platform for the City. Irvine has released a number of applications. The next step is to facilitate a continual feedback loop to understand what works and what needs to be refined. The ultimate success is not the availability of the applications, but success is measured by the use of the applications and the impact they have on the users. The GIS team needs to begin to quantify successes and engage users more proactively to identify how GIS can better serve their needs.

Desired Outcomes

In Appendix I, GIS governance models are defined and discussed. To facilitate the definition and implementation of an effective governance model and to help achieve the enterprise-level goals, there is a need to evaluate the current GIS departmental responsibilities and to determine how defining or modifying these roles may better facilitate responsible GIS growth.

A variety of Irvine departments/sections will utilize GIS in various capacities. The utilization of GIS will vary from consistent daily use to sporadic use every few weeks or months. In addition, the knowledge and understanding of GIS technology are also variable within and among these departments, such that there are GIS users from each functionality tier (i.e., Flagship user, Analytical user, and/or Browser user).

The table on the next page illustrates the current utilization of GIS in Irvine. It illustrates the current utilization of GIS by some departments and the lack of current utilization by other departments. Many departments identified the need for additional GIS functions for their department. The needs assessment identified numerous additional needs.

GIS Usage By Department

The departments listed below are the ones interviewed during the Needs Assessment portion of this project. Other departments not interviewed and not identified as current users but do have possible uses based on experience with other cities are listed as 0. The chart identifies the current GIS use by department/division 0 – not used at all, 5 – GIS is used to its fullest. The chart reflects multiple groups of highly trained staff “doing” GIS for end-user departments. However, the recommended model is for the GIS staff to enable all staff and the public to use GIS themselves for an ever-expanding list of uses.

The following table illustrates the current GIS use by department/division.

0 - not used at all

5 - GIS is used to its fullest

EXISTING IRVINE GIS USER PROFILES	
0 No/Little GIS Use	5 Maximum Utilization of GIS Technology
CITY DEPARTMENTS/DIVISIONS	USAGE PROFILE
City Clerk	0 1 2 3 4 5
City Manager's Office	0 1 2 3 4 5
Community Development	0 1 2 3 4 5
Great Park	0 1 2 3 4 5
Finance	0 1 2 3 4 5
Police Department	0 1 2 3 4 5
Public Works	0 1 2 3 4 5
Transportation	0 1 2 3 4 5

Community Services	0 1 2 3 4 5
Environmental Programs (Function not Department)	0 1 2 3 4 5
Public	0 1 2 3 4 5

Current Staffing and GIS Usage

Departments and divisions throughout the City typically have broad conceptual roles and mission statements. Often they define departmental roles and services in the context of larger organizational-wide initiatives with the overriding goal of providing the best possible services to citizens. The current roles of each department are discussed in the departmental needs assessment section of this study. This section addresses specifically the responsibilities that key departments/divisions have or should have with respect to enterprise GIS governance.

CIO's Office GIS Team

Irvine's GIS Team has responsibility for GIS software, system architecture, providing GIS services, data maintenance, and corporate spatial dataset management. **This is accomplished by providing technical support, creating and maintaining data sets, managing databases, and systems used for production, providing ancillary services such as map production, and overseeing deployment of applications. Other duties include working with departments and completing special projects.** This team has taken on more of a technical focus out of necessity. Based on the job duties assigned and performed, the GIS Team is primarily tasked with maintaining technical elements of the GIS and a variety of GIS layers. The current operational process is mainly focused on fulfilling needs as they are requested of IT/GIS. The GIS Team consists of the following GIS staff positions:

- **GIS Supervisor** – main job function is oversight of the enterprise-wide GIS, increasing adoption of GIS, prioritizing work, and ensuring its completion
- **Senior GIS Analyst and Senior GIS Applications Specialist** – lead GIS technologists focused on applications and the central geodatabase
- **GIS Analyst** – supports departments on projects and maintains key datasets
- **GIS Technician** – maintains key GIS data
- **GIS Interns** – works on data and projects. Usually two interns.

Public Safety

Has three staff positions that are power GIS users. They focus explicitly on maintaining and provisioning GIS for the Police Department. They manage the GIS data for the Intergraph 911 system. They also provide crime analytics and support the geospatial needs of the Police Department. Positions include:

- **Crime Analyst**
- **GIS Analyst Part-Time**
- **GIS Intern**

Community Development

GIS was housed in Community Development (CD) until recently. The GIS team still does a majority of GIS-related work for CD. CD has a Planner who can be considered a Power User and a planning intern who uses GIS.

Public Works

Public Works has a Program Specialist that is a Power User of GIS. They should be the largest user of GIS at the City. Integration with Lucity and maintaining GIS locations of assets merit a full-time GIS position in Public Works, which is currently filled by the Program Specialist.

Other Departments

Other departments rely on the GIS Team to assist with GIS project or they use the various GIS portals to view GIS data and do some rudimentary GIS tasks.

Current Irvine Governance Model

There is no officially defined governance model in place at the City today, although it would be best classified as a centralized model with some hybrid characteristics. GIS has evolved over time to where it is today. Today, GIS services and data are mainly under the purview of the GIS Team. GIS is currently established as a service. Today it is similar to ordering a pizza, the order is placed and the product is delivered. Some departments have begun to use GIS independently (Police). The central GIS team and the City should push to distribute GIS functions via various applications to departments. GIS should become ubiquitous for every department. GIS should become a primary tool for all departments. This will come through a large focus on training and education and targeted provisioning and refinement of GIS applications. The GIS team should encourage independence by departments but ensure that their needs are met.

Although not officially defined, the current government is a mix of governance components without a clear GIS model. The various components of GIS (support, management, and data creation) are **centralized**, the software and database itself are **centralized**, and applications like the intranet browsers are introducing **hybrid** characteristics. The current governance graphic (page 21) illustrates the current governance model at the City of Irvine. It illustrates graphically that while the CIO's Office is the central hub for GIS, it is not often the group responsible for assisting stakeholders. The GIS Team provides staff with and supports the technology. The current diagram represents a centralized approach to GIS. Additionally, the relationship to other external entities is represented in the diagram.

The following are some of the key **Existing Conditions** in regards to Irvine's GIS effort:

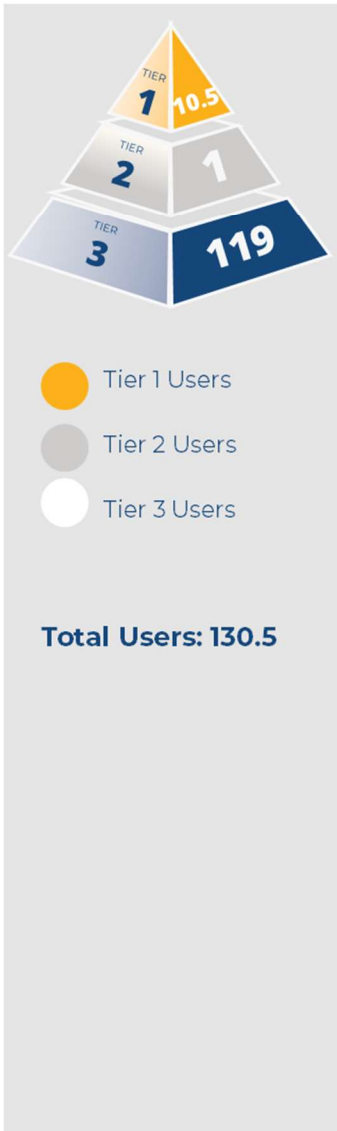
- **Centralized with hybrid components being introduced;**
- **The GIS Team is responsible for GIS software, system architecture, data maintenance, and corporate spatial dataset management;**
- **The GIS Team is responsible for maintenance of most of the corporate spatial datasets (e.g. parcels, street network, civic addresses, infrastructure)**

- GIS portals (ArcGIS Online Portals) are encouraging end-users to begin to use GIS (hybrid characteristic);
- Lack of enforceable organizational mandates – metadata, data submission standards;
- Data creation responsibilities are mainly centralized;
- No user group meets consistently;
- GIS is not governed by a steering committee;

The graphic on the following page illustrates the existing governance of GIS. The graphic illustrates the complex flow of services indicative of a centralized GIS with Hybrid characteristics. At the center, is the GIS Team provisioning GIS hardware, data, services, and software to the City. External entities (gold circles and dashed lines) interact with various GIS resources at the City. Arrows on the lines indicate the flow of data between the groups. The pyramid identifies existing users of GIS by Tier (Tier 1 – data editors/GIS experts, Tier 2 – analytical users that create derivative data, Tier 3 – viewers of data via portals).

EXISTING GOVERNANCE

City of Irvine



Gap Analysis

The previous pages of this report laid the background of how GIS is being governed today at the City and terminology/concepts of GIS governance. This remainder of the document identifies gaps and suggested governance changes/augmentation. GIS is a common need distributed across the City and GIS has been integrated into departmental workflows. Some departments have become dependent on technology and, in many cases, were not guided by corporate GIS goals. Other departments have unmet needs that can be filled with additional enterprise-wide GIS integration. Increased GIS use has created a very real need for further implementation of software tools and processes to further integrate GIS. Officializing a governance strategy with actionable goals is a priority at the City.

This strategic plan has identified another 50+ projects/needs that need to be undertaken and a host of data needs. As aforementioned, today's governance model has evolved over time with many inferred responsibilities. However, documented expectations and a governance strategy do not exist, and this chapter addresses that gap. GIS is a very different technology than other technology managed by the City. GIS needs are very diverse. A project/need may include data, applications, analytics, hardware, training, public portals, and a host of other components. Managing and prioritizing those diverse needs is the heart of how GIS is governed.

The current GIS Governance forces the organization to take a **reactionary approach to enterprise GIS**. This results in the following:

- A few adopted SOPs defining processes but the need for more;
- No visibility to users in regards to priorities;
- No adopted data management plan (see data management chapter);
- Processes are often not real-time, which degrades the temporal quality of data;
- Efficiency of communication and data sharing between departments are reduced;

- System integration is more difficult and sometimes impossible due to varying standards or lack of staff time.

The following are some of the core **Existing Challenges** that are evident in regards to an enterprise-wide GIS:

- Clarity – ensure that everyone understands the role of the GIS team and expectations of the departments;
- Transparency – no tools exist today to view and understand priorities;
- Need Improved Digital GIS Data Layers – see needs assessments and data analysis chapter;
- Need Additional Data Layers – see needs assessments and data analysis chapter;
- Have Un-Met Needs (Increased Opportunity) – many departmental needs are not being met;
- Need for Temporally Accurate Data – some data layers are not updated as needed;
- Field Tools – most departments need field access to GIS. There are no City standards nor clarity on who should be assisting for this and standard hardware and software tools that should be used;
- Applications – annual review and critique of existing applications (what works and what doesn't);
- Culture – today GIS is seen as a mapping service. Need to develop a GIS Center of Excellence Culture, whereby GIS is seen as a primary data platform for the City;
- No Annual Education Plan – a plan to proactively socialize GIS throughout the organization and with the public;
- No Annual Training Plan – many users feel they're not being afforded adequate training.

Recommended Actions

To meet the organizational GIS needs and to facilitate the desired outcome of an enterprise-wide GIS, the following actions should be taken:

- **A GIS Steering Committee (Management Team) should direct the enterprise-wide GIS**
- **Formal GIS Directives Should be Adopted**
- **Officialize a Hybrid Governance Strategy and Define Roles**

Each of these recommended actions is discussed in more detail below:

A GIS Steering Committee (Management Team) Should Direct the Enterprise-Wide GIS

The City should consider a GIS Steering Committee to guide the enterprise GIS effort. The Steering Committee should be relied upon to guide GIS implementation at a management level. This Committee's main function is to ensure that GIS is implemented effectively throughout the organization and that enterprise-wide goals and objectives are being met. The Committee should provide critical, high-level commitment to investment in GIS.

Why a GIS Steering Committee?

GIS in many organizations naturally evolves from a few users in a few departments to pervasive use by all departments over time. GIS should be seen as an organization-wide asset that impacts every department and the public. It should become the primary data dissemination platform at the City. As such, its management and prioritization should not be left in the hands of the GIS practitioners alone. This would be similar to leaving all IT decisions including applications, functions, platforms, etc. in the hands of the IT staff or to

leaving the decision making about capital projects in the hands of the field crews and field supervisors. GIS should become a fundamental platform used by all staff, the public, and decision-makers to make fundamental decisions that affect the City. As such, how it is prioritized and managed has a direct impact on saving time, lives, and money. Therefore, the most advanced and progressive GIS implementations have an executive team to guide the GIS.

GIS Steering Committee Characteristics

The City must ensure that the GIS Steering Committee consists of upper management. A management-level employee, preferably the department head, should be on the Steering Committee. Each member of the Committee will gain an understanding of the technology and feel some ownership in the GIS Program. These high-level participants will be indispensable during budgeting, and each member will serve as a champion for GIS within his or her own department.

The GIS Steering Committee **should:**

- Make it a priority to attend the meetings;
- Meet quarterly or semi-annually to guide the further implementation of GIS at the City;
- Focus on the high-level GIS direction of the organization;
- Include the CIO GIS Supervisor;
- Be comprised of high-level department staff (preferably department heads) ;
- Receive formal presentations from the GIS Division as to the direction and needs in regards to GIS;
- Decide priorities founded on available funding and overall needs of the organization based on the identified needs of the up-to-date GIS Strategic Plan;
- Make recommendations as to GIS priorities;
- Identify ways that the GIS can assist their departments;

- Understand and nurture GIS within their departments and the organization as a whole.

The GIS Steering Committee **should not:**

- Meet at a frequency that is burdensome and unproductive (quarterly initially or semi-annually);
- Discuss the nuances of the GIS implementation such as specific hardware, software, etc.;
- Be turned over to subordinate staff, which would defeat the purpose of the Committee;
- Become a venue for advancing the individual goals of a department over the overall goals of the enterprise-wide needs.

The Steering Committee meetings should be tailored to the executive level. It is understood that the department head may delegate meeting attendance to another member of their department (although not recommended). If this is done, the delegated person should report back to the department head and pertinent department staff as to key decisions. Additionally, the representative should be given full decision-making authority for his/her department in regards to GIS. Committee members should have voting rights to vote on key decisions during the GIS Steering Committee meetings. It is important for the GIS Steering Committee to have a manageable amount of members representing a good cross-section of departments. The members should be provided an agenda before the meeting and items that will require a vote. This will allow them to discuss these items with key staff in their department beforehand and request additional information if needed. It is important to decide upon the makeup of the committee and which departments get voting rights. Each of the departments that are the heaviest GIS users should have a representative who has voting rights (Public Safety, Public Works, and Community Development). Additionally, it is recommended that a representative from the City Manager's Office have a vote on this committee and two rotating representatives from other GIS using departments have a vote. It is important to note that without this level of commitment from the departments, GIS can languish. High-level support for funding and process is imperative for a successful enterprise-wide GIS.

Formal GIS Directives Should Be Adopted

City management will need to clearly define and effectively communicate the responsibilities of departments, issuing directives that give the GIS Supervisor and GIS Team the authority to set and enforce enterprise-wide GIS standards. Departments should then work within this framework to accomplish their tasks. To effectively and efficiently move forward, the GIS Supervisor and GIS Team should continue to support and integrate existing GIS initiatives while working towards enterprise standardization and creating a comprehensive list of accepted standards.

There are different kinds of decisions to be made both from an enterprise and a departmental perspective around GIS strategy, architecture, infrastructure, business applications, data, and investments. There are many nuances to each of these and there are no one-size-fits-all to who is ultimately responsible for these decisions. However, the following can serve as a guideline for the decision-making process and authority for making these decisions:

- **GIS strategy** – the basis for this is the GIS Strategic Plan. This document should be updated annually to reflect the previous year’s progress and changing priorities. The strategy for these recommendations should be vetted by the GIS Supervisor and key recommendations approved by the GIS Steering Committee. This information is the basis for an annual work plan.
- **Architecture and Infrastructure** – this strategy should come from the GIS Supervisor with consultation with key GIS staff. However, it is important that the GIS Supervisor continue to receive feedback from the users to ensure that the architecture is meeting their needs. The recommended annual user satisfaction survey will be one of many methods for receiving feedback from the departments. As a check to this process, any architectural bottlenecks should be brought to the attention of the GIS Supervisor and the GIS Steering Committee members so that the issues can be addressed.
- **Business applications** – this strategy should come from the GIS Users Group and Departments in coordination with the GIS Supervisor and his team. This method

will ensure that all affected parties have the ability to discuss functionality and have input into the selected applications and features that are included.

- **Data** - this strategy should come from the GIS Supervisor in coordination with the end-user departments. The GIS Supervisor will set data standards and give guidance as to collection methodologies, accuracy, and other key data elements.
- **Investments** – the annual strategic plan update should refresh the priorities and make investment recommendations. Direction in this area is one of the core functions of the GIS Steering Committee. The Steering Committee should guide and approve the investment made in enterprise GIS. In some cases, these investments will be made by specific departments and in other cases should be included in a central GIS budget.

Again, it is important to note that there are many nuances to GIS implementation and propagation. There are exceptions to the guidelines above. However, it is incumbent upon the GIS Supervisor and team to communicate with end-users and the GIS Steering Committee to ensure that each of the decision-making needs is appropriately addressed.

Officialize Governance Strategy and Define Roles

One of the most pressing needs for the City is to circumspectly review and understand the governance of GIS. The GIS team and the recommended GIS Steering Committee needs to take a fresh look at the GIS program based on this plan. Overall the makeup of the team is sufficient in regards to the number of staff comprising the core GIS team. However, as this plan is implemented, it is expected that the volume of use and increase in tools will necessitate an additional GIS Specialist in the future. The GIS team must have an outward focus and ensure that the GIS is simplified and growing throughout the City.

It is recommended that the City officially re-launch its GIS effort after the completion of this project. The relaunch should include the following:

- **Adoption of a GIS Vision, Goals, and Objectives;**
- **Formation of a GIS User's Group;**

- Formation of a GIS Steering Committee;
- Creation of an annual work plan with tools for tracking progress and sharing with customers;
- An annual voice of the customer survey;
- Launch of a training and education plan;
- Clearly articulate expectations of the GIS team and the users (roles and responsibilities);
- Consider an additional GIS staff resource for the GIS team as GIS use expands based on this plan;
- Presentation of all of the above to key City leaders and staff.

It is recommended that the re-launch its GIS effort. The key to the success of this re-launch is understanding the role of the GIS team and GIS Supervisor. The GIS Supervisor is critical to the continued growth of the GIS. The next sections are going to clarify the role of the GIS Supervisor. However, some of the tasks discussed can be given to other GIS team members. Therefore, the following discussion references the role of the GIS Supervisor but can mean the GIS team in a bigger context.

The GIS Supervisor should have the authority to enforce GIS-related mandates and decisions throughout the organization. The GIS Supervisor should have the mandate to coordinate all geospatial efforts to ensure Irvine's holistic GIS needs are being met. That is not to say that the GIS Supervisor will be the direct supervisor of the various GIS staff (or power users) in other departments at the City but have the authority to establish and enforce standard operating procedures, implement standards, and promote enterprise-wide GIS. The GIS Supervisor, under the guidance of a recommended GIS Steering Committee, will work closely with the City as a whole to ensure that GIS standards are being adhered to and met.

This strategic plan should serve as the rudder of the ship. However, the ship also needs a knowledgeable captain on board. All of the most successful GIS programs have a full-time program leader capable of overseeing the entirety of the organization. Having this person is the most important component of GIS success because leadership can make or break the program and its associated projects. The following defines expectations of the GIS Supervisor and team.

The lead GIS person for a City is critical to the programs sustained success. In the case of Irvine, the lead GIS person is the GIS Supervisor. **The title of GIS Supervisor reflects the far-reaching and enterprise-wide nature of GIS at the City and the position high-level responsibilities.** The GIS Supervisor must have the technical savvy to run diverse operating systems, networks, and GIS software and the people skills to coordinate, sell, champion, teach and referee the implementation of this revolutionizing technology. This position must be seen as a City-wide asset and as such needs to serve the entire organization with autonomy.

Why a Full-Time GIS Supervisor?

There are many questions asked in regards to the GIS Supervisor position. Do we really need the position to run our GIS? In which department should we put GIS Supervisor? What is the role of the GIS Supervisor and GIS Team? These questions are not to be answered lightly. Organizations have spent millions of dollars on GIS just to see the project fail because these questions were not addressed properly. GIS projects are inherently complex. Decisions have to be made about hardware, software, networking, data standards, data sharing, data security, database design, data maintenance, data creation, priorities of data layers, training, programming, etc. Determining who will be responsible for these tasks is a full-time job in and of itself.

To build a fully functional GIS, the GIS Supervisor will have to ensure that all departments get involved and that data is shared between departments. Departmental expectations must be defined. A GIS work plan must be shared and given ongoing visibility. A continuous customer feedback loop is imperative. The GIS Supervisor should receive guidance from a GIS Steering Committee in regards to GIS priorities. Inevitably, departments will disagree on how a GIS should be implemented. It is up to the diplomatic GIS Supervisor to see that disagreements are resolved in a manner acceptable to all parties, including external agencies. In some cases, the GIS Steering Committee will have to advise. In Wilson, North Carolina, potentially divisive issues relating to accuracy and cost of data to the public arose between departments. These important issues were met head-on and resolved by gathering all involved parties before problems could occur. With the help of their GIS Supervisor, users come up with a mutually acceptable solution.

GIS Team Location within the Organization?

It seems natural to put the GIS Supervisor and Team in the department that seems to need GIS technology the most. Irvine, like many city governments, has users throughout the organization with a heavy concentration on Planning, Public Safety, and Public Work's needs. If Irvine is going to have a successful enterprise-wide GIS, the GIS Supervisor should be autonomous and able to serve all departments equally. GIS has migrated from and to various departments at the City. This is not atypical. However, it could signal to the organization that there is a lack of clarity about the role of GIS.

When the GIS lead is in a user department, there is a risk that the department gets much better treatment than other departments. The GIS Supervisor is faced with a dilemma: "Do I work on the project that will please my boss, or do I spend my time helping other departments?" More often than not, the Manager will satisfy the boss. As seen in Irvine, when GIS was in Community Development it was primarily a Community Development tool with pockets of use in other departments. Additionally, GIS staff within a GIS using department soon become experts in what that department does and as a result, become more comfortable doing the tasks of that department. Other departments soon feel isolated, grow resentful, and begin to lose interest in the GIS project. Support for the project as a whole will begin to erode. Instead of breaking down traditional barriers, this mode tends to erect new ones.

City staff has indicated that the City desires that GIS should be promoted as an enterprise-wide asset in which each department is provided with the tools necessary to accomplish their daily tasks. This requires a commitment from leadership. Some departments who might have historically needed GIS but did not adopt its use will need to commit to GIS as part of their core functions. In the past, this was more difficult because the software was too difficult to use. However, today there are numerous tools that allow staff to use GIS easily to view and analyze data to get their job done. Therefore, it makes sense that the GIS Team is in the CIO's Office and should remain there. The organization should understand why it is in the CIO's Office and the role of the GIS Team.

Arguably the most important factor in the success of GIS is the GIS Supervisor. The GIS Supervisor needs to understand the role and how to ensure enterprise-wide success. All too often a GIS team (especially in IT) focuses too much on the technology itself and not enough on educating and promoting the technology. The bottom line is that non-GIS staff at the City

need to understand how GIS can help them do their job. GIS is a pervasive technology and as such one of the primary roles of the GIS Supervisor should be promoting GIS understanding and usage. Additionally, a GIS Supervisor has to give clarity to users on expectations and ensure customer satisfaction. The following are characteristics that need to be considered to be an effective GIS leader in an organization. Again, this discussion focuses on the GIS Supervisor but the discussion applies to the GIS Supervisor plus key members of the GIS team.

Characteristics of an Effective GIS Supervisor (GIS Team)

The role of the GIS Supervisor can be tricky. The ultimate success of an organization's GIS will rest squarely on the shoulders of the GIS Supervisor, who must be several things:

Technically proficient but not intimidating. Today's GIS Supervisor must understand a diverse range of technological issues-computer networking, database design, integration with other IT systems, various GIS software, mobile computing, data conversion, etc. If the Supervisor does not have a tight grasp on the technology, the GIS will languish.

It is important that the Supervisor not only know the technology but also be able to share this knowledge with staff. The Supervisor must determine each user's level of expertise and relate the technology in terms that each user can understand. The GIS Supervisor must also avoid confusing and frustrating users, or antagonizing them by engaging in technical one-upmanship.

A geographer. It is said that 95 percent of everything done in local government has a geographic component. The GIS Supervisor must understand geography and be familiar with proper mapping techniques and geographic constructs. A formal background in geography is desirable. An extremely competent computer person may fail as a GIS Supervisor because he or she does not understand geography. The GIS Supervisor must ensure depth of geographic understanding for himself and the team. They should understand projections, coordinate systems, and cartographic concepts. Any deficiencies should be corrected through training and education. Internal team training is important on an ongoing basis. This can be short 30-minute lightning discussions or brown bag lunches.

A salesman. “Be everywhere, do everything, and never fail to astonish the users.” This spin-off of the Macy’s department store motto makes a good motto for the GIS Supervisor. The GIS Supervisor has to become the champion of GIS in the organization. Whenever technology is advanced, there will be skeptics. It is up to the Supervisor to quiet the skeptics and tout the benefits of GIS to the organization. The Supervisor should make sure that every department knows what GIS can do for it. Newsletters, presentations, informal conversations, and magazine articles should be used to educate users about the technology. It is important that the Supervisor have people skills and be able to articulate the benefits of GIS. A good GIS salesman can quiet even the harshest of critics.

A diplomat. Diplomacy has been defined as the art of letting someone else have your own way. GIS will continue to change the way Irvine operates. Whenever a revolutionary technology such as GIS is adopted, change will occur. Old, inefficient ways of doing business have to be evaluated and sometimes jettisoned. Often, this will not go over well with some staff. It is critical to be diplomatic in these situations. The Supervisor needs to make sure that no one feels alienated. If possible, it is best to prompt users into coming up with ideas on how to change their operations using a GIS instead of coming in and trying to force change.

Each of the above characteristics must be cultivated and action items need to be included in monthly work plans. The GIS team must avoid the “IT Fallacy” – waiting for users to come to them and passively operating the program instead of actively operating the program. To that end, the recommended annual Voice of the Customer survey and other feedback mechanisms should be prioritized.

GIS Staff Authority and Responsibilities

It is important to everyone throughout the organization to clearly understand the role of the central GIS team and what is expected of departments. Also, the City needs to consider that under a GIS Steering Committee led Hybrid Model, the GIS Team should have a dual accountability to the Steering Committee in the sense that the Steering Committee should have an oversight role with respect to City GIS initiatives to ensure that as the Supervisor carries out the noted responsibilities there is full departmental buy-in and consensus. The whole “hybrid” concept requires a collaborative and consensus-based approach. The following is a list of suggested responsibilities of the GIS Team:

- Recommend software and hardware standards for all geospatial technology (must align with overall City IT standards);
- Work closely with the power users in other departments;
- Collaboratively review the acquisition of all geospatial software and hardware (GIS, GPS, AVL, others) in coordination with the departments;
- Set database standards for all GIS data;
- Implement and extend geodatabase standards and designs for key data sets;
- Enforce quality assurance and quality control standards for all GIS data. Departmental data quality and accuracy is a decision of the departments. However, the GIS Team is tasked with enforcing generally accepted QA/QC standards;
- Provide and recommend City GIS educational opportunities for the organization;
- Enable the ability for departments to maintain their own GIS layers where appropriate. This typically depends on the volume of GIS work done by departments. Some departments/divisions will use GIS peripherally and will not have the resources/expertise to maintain their own data. See recommendations in the Data Chapter for more details.
- In conjunction with departments, select and provide enterprise-wide tools for departmental staff to conduct geospatial analysis and browsing;
- Collaborate and assist in the selection of public-facing geospatial portals, ensuring compliance with software standards;
- Provide mechanisms to geo-enable existing non-GIS databases;
- Oversee and administer a communications plan for GIS;
- Maintain and enforce the use of a GIS help desk;
- Conduct an annual user satisfaction survey;

- Conduct an annual return on investment analysis (new GIS investments) of GIS at the City;
- Provide technical expertise for the creation of specialized GIS products or analysis;
- Provide advice and consultation as to the use of GIS at the departmental level;
- Educate the organization about infrastructure, policies, usability, and how changes in one layer may impact another layer where practical;
- Ensure that departmental level staff is adhering to City-wide standards. If not, rectify the situation through departmental staff supervisors and/or the GIS Steering Committee. This does not mean that onerous data quality and accuracy standards will be introduced. This refers more to data formats, software standards (Esri), and other agreed-upon City standards.

Departmental Responsibilities

The following is a list of GIS duties that should be done by end-user departments:

- Maintain staffing levels to support departmental GIS need – having a formal central GIS Team does not abrogate departmental authority for providing resources for their own needs;
- Utilize enterprise-wide data viewers and tools to create maps and reports as needed;
- Maintain departmental specific data layers as appropriate;
- Participate in the use and growth of geospatial tools;
- Ensure that staff attend the internal training classes on GIS where appropriate;
- Utilize the GIS help desk;
- Give candid feedback to the central GIS staff as to how GIS is meeting their needs.

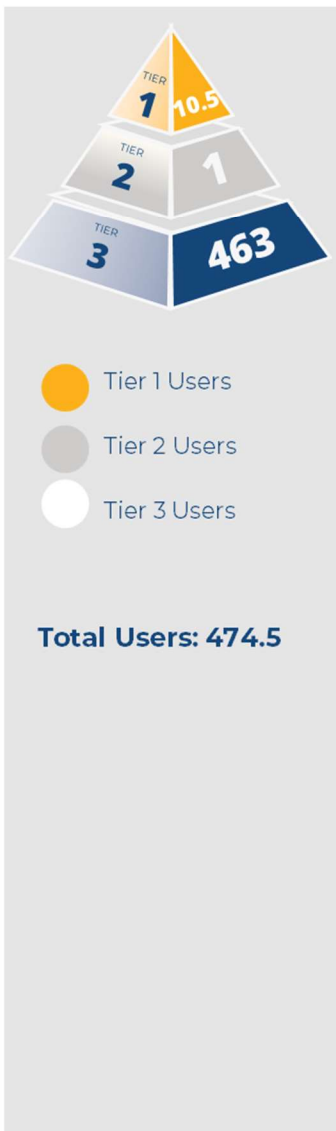
Additionally, staff working on GIS projects should be accountable to their own department but also to the GIS Manager. This dual accountability can only work if this model is officially adopted by the organization and the GIS Steering Committee. The Hybrid model can be modified to accommodate current mission-critical and department-based GIS operations, as well as lay the foundation for enterprise-level ownership and corporate oversight of many current and future GIS processes. Many organizations have to make radical changes to their GIS governance in regards to the level of GIS staffing and positioning within the organization. However, the City has an adequate number of GIS staff in the short term and should consider another GIS staff person in a few years as GIS usage expands. GIS being in IT (CIO's Office), having a lead GIS position and having a centralized group of core experts are industry best practices that should continue. The diagram on the next page shows the future GIS governance model. The diagram is similar to the current GIS Governance Model diagram with the exception of additional users in departments, an eventual additional staff person in the GIS team and additional flow between departments and the central GIS team.

Expand the Technical Project Manager Practice to GIS

As discussed earlier, the CIO has instituted the use of Technical Project Managers to act as liaisons to departments so that they can better understand the needs of the departments and provide services/solutions targeted to meet the needs of the departments. These Project Managers should work closely with the GIS Supervisor to integrate the findings of this report into the overall City technology work plan and ensure that the recommendations in this report are fully understood by the Project Managers. Most of what is recommended in this plan need to be fully understood by the Project Managers so they can best guide the departments and integrate GIS into the solutions for which they have oversight and give expert advice. To that end, the GIS Supervisor should meet monthly with the Project Managers to reciprocally review GIS activities and departmental IT activities. This would ensure that GIS is aligning with the CIO's overall vision of providing impactful solutions to the departments.

FUTURE GOVERNANCE

City of Irvine



GIS Communication and Education Strategy

Introduction

As the City looks to expand the use and reach of GIS, staff will need to develop and maintain strong foundational knowledge of GIS. This includes three distinct components – training, education, and knowledge transfer. Each component is vital to ensuring GIS success in the City of Irvine. Improving the GIS knowledge base within each department should be a goal of the GIS team. During the onsite interviews, it was identified that there is no formal GIS training plan in Irvine. A developed training, education and knowledge transfer plan will encourage the effective utilization of GIS technology and is a critical piece of the GIS program sustainability. The terms are defined as follows:

- **Training** – a formal class or session, for a group or individual, intended for the purpose of learning a skill or software tool. Training can be informal or instructor-led and can be off-site, on-site, or Internet-based.
- **Education** – a variety of methods and techniques used to teach the organization how GIS should and can be used. This can include seminars, one on one discussions, brown bag lunches, and various digital communications mediums.
- **Knowledge transfer** – the act of educating and/or training others in the organization about specific skills or techniques that a person or persons have that can benefit others in the organization.

GIS Training

Training should revolve around a strategy that includes external training, internal training, and continuing education offerings. The training model should follow the 3-tiered structure.

- A **Tier 1 User** is a Flagship GIS user who has access to a fully functioning GIS toolset including editing and complex analysis. Tier 1 users are those that use the entire ArcGIS suite, GIS data managers, and/or career GIS professionals.
- A **Tier 2 Analytical User** focuses on data analysis, in addition to general browsing capabilities. Tier 2 users conduct analytical tasks above and beyond what is offered at the Tier 3 level. They need a tool that allows for robust flexibility and a host of analytical tools such as those provided by ArcGIS Desktop Basic.
- A **Tier 3 Browser User** requires only general browsing, simple cartographic output, and basic GIS data query functions. Generally, Tier 3 users can have the majority of their GIS needs met by Internet and/or Intranet browser-based map applications.

User training will need to start first and foremost with core GIS staff. GIS staff will need to receive additional training on how to use Esri software to accomplish their assigned tasks. In addition to obtaining the necessary knowledge to ensure operational success and bolster their own technical skills, it is recommended that a some of the GIS Team are proficient in GIS training to a degree that they can carry on training with other Irvine employees. Discussed later in this section, the GIS Team should use a “train the trainer” model to propagate their GIS skills and knowledge through training and educational seminars to other City GIS users.

ArcGIS Training Recommendations

It is important to note that the following recommendations do not account for existing expertise. For example, staff with experience in Esri software might not need to take introductory ArcGIS I classes. However, some staff will likely need introductory classes to familiarize themselves with ArcGIS tools and processes.

GIS training is mission-critical to the success of GIS within Irvine and there are many options for GIS training. Esri offers a host of GIS classes in training centers as well as numerous low-cost and free, self-paced courses available online. Esri courses are changed on a yearly or bi-yearly basis, depending on new releases and updates. The latest Esri training course offerings should be re-evaluated regularly. The City could potentially partner with Orange County, neighboring cities or private organizations to share some of the costs of some of

training. Esri provides the option of on-site private training, which can be hosted at Irvine. These arrangements are made on a class-by-class basis. There are also consultants that can conduct on-site training for staff, often at a lower cost than Esri training.

Staff in the GIS team should take the Esri courses pertinent to the classes for which they will teach. They then should tailor a course to the City's GIS end-users. Esri courses cover a wide range of topics, some of which are not pertinent to city GIS users. The GIS team should familiarize themselves with the needs of city staff. Then, the GIS team can customize each in-house course to focus on relevant topics tailored to the needs of the city's GIS end-user community. These classes do not need to be the same duration as the Esri courses as the GIS team's training should be more concise and targeted.

GIS Training Matrix

The following matrix identifies several Esri training courses that would provide staff with the knowledge to maintain the Esri-based GIS platform. The matrix summarizes the recommended training class regimen for the City. The table includes the class, location, trainer, recommended audience, suggested prerequisites, a brief course description, course length, initial offering plan year and estimated cost.

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
ArcGIS 1: Introduction to GIS (10.4+)	Off-Site/ Online	Esri/ Internal	Tier 1 and 2 Users, some Tier 3 Users who will utilize ArcGIS Desktop	None	Concepts and tools used to visualize real-world features, discover patterns, obtain information and communicate that information to others. Introduces ArcMap and ArcGIS Online.	2 Days	Year 1 The GIS Team should take the course and then begin training other staff.	\$1,210 per attendee
ArcGIS 2: Essential Workflows (10.4+)	Off-Site/ Online	Esri/ Internal	Tier 1 and 2 GIS Users	ArcGIS 1: Introduction to GIS	Skills to perform the most common ArcGIS Workflows using ArcMap and ArcGIS Online	3 Days	Year 1 The GIS Team should take the course and then begin training other staff.	\$1,815 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
ArcGIS 3: Performing Analysis (10.4+)	Off-Site/ Online	Esri/ Internal	Tier 1 and select Tier 2 GIS Users	ArcGIS 2: Essential Workflows	Standard workflows you can apply to any spatial analysis project using ArcGIS for Desktop Advanced and ArcGIS Spatial Analyst extension.	2 Days	Year 1 The GIS Team should take the course and then begin training other staff.	\$1,210 per attendee
ArcGIS 4: Sharing Content on the Web	Off-Site/ Online	Esri/ Internal	GIS Team and those responsible for the creation of web maps.	ArcGIS 2: Essential Workflows	Attendees will learn how to publish professional map services that will provide spatial data to colleagues and non-GIS audiences.	3 Days	Year 1 staff responsible for developing web maps and applications should take the class	\$1,815 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
Creating and Editing Data with ArcGIS Pro	Off-Site/ Online	Esri/ Internal	Tier 1 and 2 Users with data maintenance or creation roles	ArcGIS Pro: Essential Workflows	This course teaches best practices to create accurate geographic data and maintain it over time. You will get ample hands-on practice with a variety of ArcGIS Pro tools that streamline the editing process and decrease the potential for errors when updating your GIS database.	2 Days	Year 1 The GIS Team should take the course and then begin training other staff with data maintenance roles.	\$1,210 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
Deploying and Maintaining Multiuser Geodatabase	Online	Esri/ Internal	GIS Database Designers and Administrators	ArcGIS 2: Essential Workflows	This course prepares you to successfully create a multiuser geodatabase to store and manage your organization's geographic data. You will learn about the multiuser geodatabase architecture, configuration options and techniques to efficiently load data, assign user privileges and maintain database performance over time.	2 Days	Year 1 staff responsible for database creation and maintenance should take the class	\$1,210 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
System Architecture Design Strategies	Online	Esri/ Internal	GIS Technical Leads and System Administrators	Review the System Design Strategies wiki site at www.esri.com/systemdesign .	This course covers GIS system architecture design strategies. Learn how to plan and select the right system architecture for your organization.	3 Days	Year 1 staff responsible for the GIS infrastructure administration should take the class	\$1,815 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
Putting ArcGIS to Use Across Your Organization	Off-Site/ Online	Esri/ Internal	GIS Team	Familiarity with GIS/ArcGIS 1: Introduction to GIS	This course will provide a comprehensive introduction to the ArcGIS platform components and capabilities. Explore ArcGIS apps used for mapping and visualization, data collection and management, spatial analytics and collaboration and sharing.	3 Days	Year 1 The GIS Team should take the course and train other staff as needed on the capabilities and offerings of the latest Esri tools.	\$1,815 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
Migrating from ArcMap to ArcGIS Pro	Off-Site/ Online	Esri/ Internal	GIS Team	ArcGIS Pro: Essential Workflows	This course prepares experienced ArcMap users to be productive right away. Learn essential ArcGIS Pro terminology and concepts and how to efficiently complete a variety of tasks related to mapping, editing, analyzing and sharing geospatial data and resources.	2 Days	Year 1 The GIS Team should take the course and train other staff as ArcGIS Pro is further adopted.	\$1,210 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
ArcGIS Pro: Essential Workflows	Off-Site/ Online	Esri/ Internal	GIS Team	Introduction to GIS	This course introduces techniques and general best practices to map, manage, analyze and share data and other GIS resources. Hands-on exercises will give you the experience needed to efficiently work with ArcGIS Pro.	3 Days	Year 1 The GIS Team should take the course and train other staff as ArcGIS Pro is further adopted.	\$1,815 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
Sharing GIS Content Using ArcGIS	Online	Esri/ Internal	GIS Team	ArcGIS Pro: Essential Workflows OR Migrating from ArcMap to ArcGIS Pro	Learn how to efficiently share a variety of geospatial resources to an ArcGIS Online organizational site or ArcGIS Enterprise portal website.	2 Days	Year 1 staff responsible for developing web maps and applications should take the class	\$1,210 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
Configuring Web Apps Using Web AppBuilder for ArcGIS	Off-Site/ Online	Esri/ Internal	GIS Team	Creating and Sharing GIS Content with ArcGIS Online	Learn how to easily create intuitive, focused web apps that are accessible on desktop and mobile devices—without writing any code. This course shows how to take advantage of existing web maps, themes and widgets to build apps that feature your organization's branding and deliver the functionality your users require.	1 Day	Year 1 The GIS Team should take the course and then begin training staff that will create and share content through Esri's Web AppBuilder	\$605 per attendee

Class	Location	Trainer	Recommended Audience	Suggested Pre-Requisites	Course Description	Course Length	Initial Plan Offering Year	Estimated Cost
Field Data Collection and Management Using ArcGIS	Off-Site/ Online	Esri/ Internal	GIS Team, supervisors and individuals who will gather data in the field	Putting ArcGIS to Use Across Your Organization	This course will teach how ArcGIS supports a complete field data management workflow – from the office to field, in the field and back to the office.	2 Days	Year 1 The GIS Team should take the course and then begin training staff that will rely on mobile applications and field collection.	\$1,210 per attendee

Training Classes – Tier 3

Tier 3 users will need training specific to the GIS intranet portal, mobile and/or field applications, dashboards, and story maps. These training classes can be handled on-site on an as-needed basis by the GIS Team and/or selected consultants. Enterprise-wide training of Tier 3 applications can be conducted by members of the GIS Team or third-party consultants depending on the use case. For example, a class on the use of a tier 3 intranet application should be offered throughout the year by internal staff.

Multi-Year Training Plans

The following table lists the recommended training class and recommended number of classes per plan year. Irvine should expect to participate heavily in GIS training as the transition to 10.6.1 and ArcGIS Pro occurs. After year 5, classes should be provided on an as-needed basis with an eye on staff turnover and/or new releases of technology.

ArcGIS Training Classes					
Class	FY1	FY2	FY3	FY4	FY5
ArcGIS 1: Introduction to GIS (10.4+)	1	0	1	0	1
ArcGIS 2: Essential Workflows (10.4+)	1	0	1	0	0
ArcGIS 3: Performing Analysis (10.4+)	1	1	0	1	0
ArcGIS 4: Sharing Content on the Web	1	0	0	0	0
Creating and Editing Data with ArcGIS Pro	1	1	0	1	0
Deploying and Maintaining a Multiuser Geodatabase	1	0	0	0	0
System Architecture Design Strategies	1	0	0	0	0
Putting ArcGIS to Use Across Your Organization	1	0	0	1	0
Migrating from ArcMap to ArcGIS Pro	1	0	0	0	0
ArcGIS Pro: Essential Workflows	1	1	1	0	0
Sharing GIS Content Using ArcGIS	1	0	0	0	0

Configuring Web Apps Using Web AppBuilder for ArcGIS	1	0	1	0	0
Field Data Collection and Management Using ArcGIS	1	1	1	1	1
Tier 3 Applications					
Tier 3 Applications	3	3	3	3	3

Additional Enterprise Training

In addition to the instructor-led classes, as previously discussed in this chapter, there are a vast array of GIS educational classes available with a maintenance license through Esri's online training catalog, which is included with an Esri subscription. Many of these training opportunities and videos are shortened versions of the instructor-led classes discussed above and would benefit users who do not perform GIS work full time. Staff should utilize these opportunities when possible. There is a large catalog of videos, training seminars and web courses that cover a wide array of GIS topics. Some are extremely specific, such as Tapestry Segmentation, while others would benefit entire divisions of staff in the City. The table below identifies some of these free, self-paced, online offerings that should be explored by staff in Irvine.

Course	Type	Length	Recommended
Getting Started with GIS	Web Course	4 Hours	Users unfamiliar with GIS
Referencing Data to Real-World Locations Using ArcGIS	Web Course	3 Hours	Users who will be creating and maintaining data in ArcGIS for Desktop
Finding Geographic Data in ArcGIS	Web Course	2 Hours	Tier 2 Users
Solving Spatial Problems Using ArcGIS	Web Course	2 Hours	All Users
Creating and Sharing GIS Content using ArcGIS Online	Web Course	3 Hours	Tier 1 and 2 Users Creating ArcGIS Online Maps

Continued Growth and Education

An important part of professional GIS education is not only formal training classes, but also attending GIS conferences, being active in professional organizations, and joining area or regional user groups.

In addition to their regional and national users' conferences, GIS professional associations offer important peer-to-peer connections, professional journals, and technical publications, training and other learning forums, and opportunities to form local, regional and national policy by serving on select committees and special interest groups. Some prominent GIS professional organizations include:

Geospatial Information Technology Association (GITA)

<http://www.gita.org/>

GITA is the professional association and leading advocate for anyone using geospatial technology to help operate, maintain, and protect the infrastructure, which includes organizations such as utilities, telecommunication companies, and the public sector. Through industry-leading conferences—along with research initiatives, chapters, membership, and other programs—GITA provides education and professional best practices.

Urban and Regional Information Systems Association (URISA) – Southern California Chapter

<https://www.urisa.org/chapters/southern-california-chapter/>

URISA is a nonprofit association of professionals using Geographic Information Systems (GIS) and other information technologies to solve challenges in state/provincial/ regional, and local government agencies and departments. The Southern California Chapter has been an active part of URISA since 1990. Our Chapter service area is made up of Southern California counties including Los Angeles, Orange, Riverside, San Bernardino and San Diego, and the recent addition of Imperial, Santa Barbara, and Ventura Counties. The Chapter holds local meetings throughout the year and regularly hosts URISA Certified Workshops that are free to members. The SoCal Chapter also co-hosts the annual California GIS conference with

BAAMA (Bay Area Automated Mapping Association), Central California URISA and Northern California URISA.

American Association of Geographers (AAG)

AAG is a nonprofit organization comprised of members from the public, private, and academic sectors focused on contributing to the advancement of geography. AAG consists of members representing over 100 countries. AAG hosts an annual meeting and publishes several scholarly journals and an online newsletter.

Orange County GIS Users Group

Local hosted regional users group.

Geographic Information Systems Professional (GISP) Certification

The GIS Certification Institute (GISCI) is a non-profit organization that provides the GIS community with a certification program. Experienced GIS professionals can obtain GISP certification and recognition provided they meet the following requirements.

- **Have 4 years equivalent full-time geospatial experience;**
- **Meet the Portfolio Requirements (minimum point requirements in Education, Experience, and Contributions);**
- **Take and pass the GISCI Geospatial Core Technical Knowledge Exam;**
- **Complete all requirements within 6 years from the start of the application process.**

Annual Esri Conference

GIS conferences allow registrants to attend workshops and seminars (some free, some at additional cost), and to interact with other GIS professionals from around the world. The City of Irvine should budget every year for conference attendance. The International Esri User Conference is the premier GIS learning experience and should be attended if possible. There are over 16,000 attendees annually from over 130 countries. There is no peer to the Esri User Conference. This is the most important and far-reaching conference conducted for Esri

users. The breadth of the educational opportunities and access to Esri staff can only be found at this conference. For more information: <http://www.esri.com/events/user-conference>.

Who Should Attend?

The Esri User Conference is open to all Esri software users including:

New User	Experienced Users
User Group Members	Supervisors
Programmers	Specialists
Analysts	Technicians
Local, Regional, National, and International Committee Members	Management Information Services and Industry Solutions Supervisors
Project Coordinators	Department Heads
Division Chiefs	Executive Directors
Faculty	Elected Officials
Board Members	Chairpersons
NGO Representatives	First Responders

In addition to the Esri International User Conference, the professional organizations mentioned holding annual conferences. Some of these are regional annual events, while others are national or international conferences. Irvine should make every effort to attend conferences including the California GIS Conference as they are tremendous sources for new ideas and will assist the City in staying current in industry best practices.

Communication and Knowledge Transfer Plan

Knowledge transfer is equally important as formal training and education. GIS must be understood, and the organization must be educated as to the benefits and uses of GIS technology. Irvine must make a conscious effort to continually disseminate information within the organization as well as to the public. Therefore, it is important to have a knowledge transfer plan.

The purpose of this plan is to help an organization communicate with internal and external audiences. As the GIS is expanded, communication is vital. GIS staff needs to communicate and report progress to stakeholders regularly. It is critical that GIS is communicated in an organized and deliberate fashion at the City. Some of the reasons for the City to communicate regarding GIS are as follows:

- **Keep stakeholders informed about City GIS activities**
- **Provide ongoing project updates**
- **Distribute major reports and findings**
- **Educate GIS users as to approved standards**
- **Educate people about the benefits of GIS**
- **Make people aware of the City's GIS activities and the impact they are having**
- **Solicit and acquire input related to City GIS activities**
- **Understand the needs of the GIS user community**
- **Provide sound policy advice to decision makers**
- **Promote programs that the City thinks are critical to sound GIS development**
- **Promote the use of GIS in meeting objectives of key stakeholders**

This knowledge transfer plan is meant as a guide for the City's GIS development efforts. It describes the audiences that should be hearing from the City and ways to reach them. Additionally, it talks about ways of getting feedback as well as receiving communication from key audiences. The City should incorporate numerous ways to communicate with its audience. Following are the audiences that would typically be included in the communications plan:

- **GIS Users Group** - Users that need to be kept in the loop on pertinent City directed GIS activities
- **Department Heads** - One-on-one meetings to discuss how GIS can and should be used in their department
- **City Leaders** - Decision makers need to understand GIS and why it is being used
- **Community Groups** - Meetings with various community groups to explain the technology and some of the applications available
- **Other Agencies** - Discussions with key partner agencies and private organizations in regards to collaboration
- **General Public** - Peripherally aware of technology; need events/stories in the media to better inform
- **Surveyors** - Could support improving accuracy standards and modernization of data

Communication Method

Various methods exist that will allow the City to communicate its GIS message both internally and externally. Some methods like email, brochures, newsletters, the City's website, and City Council meetings are always available and easily accessible. Other methods require significant effort and cost to create and distribute. These include published articles, annual reports, presentations at GIS conferences and developing or updating strategic plans. The City will need to review the various communication methods available and decide which methods would best suit its needs. The following is a list of suggested communication methods, their frequency, and costs:

GIS Steering Committee

Should meet quarterly at a minimum

- Serves to keep decision-makers informed and guide GIS implementation and priorities
 - Cost- \$0

GIS User's Group

Should meet monthly

- Serves to keep GIS users apprised of technology changes, City standards, and GIS direction
 - Cost - \$0

GIS Day

November of every year

- Should participate and promote each year
- Opportunity to share GIS successes with the organization and public
 - Nominal cost – booth and various displays

Annual User Satisfaction Survey and Report (Voice of the Customer)

January of each year

- Users should be given an anonymous survey that allows them to give candid feedback as to how well GIS is meeting their needs
- Data should be compiled in a report and shared with the City
 - Cost- \$0

Annual Strategic Plan Update

March of each year

- The strategic plan should be a living document. It should identify successes, changes in technology and reprioritize GIS needs/expenditures each year.
 - Cost- \$10,000

One-on-one Meetings

Monthly

- The Enterprise GIS Supervisor
- Should meet one-on-one with key decision makers each month to apprise them on how GIS is progressing to meet their needs. Also, this is a terrific way to educate decision makers on other ways their department can use the technology.
 - Cost - \$0

Presentations to City Council

Annually

- High-level presentation to City Council detailing how GIS is improving the City and expanding services
 - Cost - \$0

Blogs, Email, and Social Media

As pertinent

- GIS staff should establish several conduits for disseminating pertinent information, sharing ideas and making announcements. Various digital mediums should be leveraged for this. Internal and external customers should be provided with information via various conduits.
 - Cost - \$0

Newspapers and Television

As pertinent but at least once a year

- GIS staff should leverage the press. As exciting projects are completed, the story should be shared with media outlets. In most cases, they are looking for interesting stories and will gladly work with the City to publicize GIS successes.
 - Cost - \$0

Brochures, Newsletters and Other Marketing Efforts

Throughout the year

- GIS staff should try to market successes and services. Brochures describing what GIS services, newsletters, the City website, and other methods should be used to promote GIS throughout the City
 - Cost - \$0 unless a professional firm is used to create an identity or brochure

Seminars

Throughout the year

- Formal software training is needed but should be augmented with seminars that discuss GIS in a broader context. Seminars such as a GIS Manager's Workshop or Return-on-Investment with GIS are great ways to share how GIS can benefit an organization. These can be conducted by internal staff, although, a budget should exist to bring in outside speakers for key topics.
 - Cost - \$15,000 annually

Succession Planning

One key part of communication and knowledge transfer that is frequently overlooked is succession planning. When key personnel retire or leave the organization, the information they had accumulated during their time with the organization leaves as well. There are numerous examples where organizations lose key members of their staff and the GIS program suffers. In extreme cases, the loss of a key person might mean the discontinuance of a program. Local governments often do not think about succession planning and just make things work after losing a key employee. This often means a loss of institutional knowledge and in some cases recreating work already completed by the departing individual. For example, a municipal organization in a university town lost its lead GIS person. The parting was not on good terms and the departing staff person did not leave documentation of the GIS processes, databases, and other key elements of the GIS. This necessitated the use of an expensive consultant to analyze the systems and to create a “best guess” of data veracity and completeness and to spend a large amount of time understanding and documenting programs and automated processes. It is important to have a succession plan that focuses on program sustainability. This includes a variety of technical components (standardizing and documenting databases and processes) and personnel considerations. The City of Irvine needs to have a succession plan in place so that when individuals leave the organization, the GIS training and institutional knowledge they acquired is passed to other individuals. This ensures there will not be a lag in organizational capacity when staff leave or turnover occurs. This includes efforts to cross-train GIS staff and a disciplined approach to documenting processes and accomplishments.

Training, Education, and Knowledge Transfer Conclusion

As the City continues to develop and grow its enterprise GIS, it is becoming increasingly necessary that strong and consistent communications are maintained with all GIS stakeholders internally and externally. The implementation of a pervasive education and communication plan will help to establish and formalize those lines of communications which in the long run, will help the City further improve the enterprise GIS while providing maximum value to its stakeholders.

Summary of Organizational Readiness Recommendations

Many organizations have to make radical changes to their GIS governance in regard to the level of GIS staffing and positioning within the organization. However, the City has an adequate number of GIS staff in the short term and should consider another GIS staff person in a few years as GIS usage expands. GIS being in IT, having a lead GIS position and having a centralized group of core experts are industry best practices that should continue.

The following tasks are recommendations based on best GIS business practices in local government and the key factors for deploying an enterprise and scalable solution that will sustain the City of Irvine well into the future. GIS governance is the first and critical step in maintaining an enterprise, sustainable and enduring GIS. Without good GIS governance and a good governance model within an organization, there is a lack of cohesion and authority. The organization does not have clear lines of communication and accountability. Good GIS governance creates a vision, and goals and objectives, and ensures GIS usage that is both attainable and beneficial for all departments. A good governance model is an essential ingredient in building a true enterprise, sustainable and enduring GIS. A result of good governance is a well-executed training and education plan. Some of the most successful GIS programs have languished because they did not focus on educating their organizations as to the power of GIS. The following tasks are a summary of the key elements from this chapter:

Task 1: Create a GIS Steering Committee

A GIS steering committee is a group that is composed of top-level organizational leaders. A coherent GIS steering committee is crucial for a smooth implementation process, as it allows direct interfacing between executive decision-makers and GIS experts. The City of Irvine should create a GIS Steering Committee comprised of directors from key departments, as well as develop a strategy for the Steering Committee's goals and objectives. A Steering Committee is very important to ratify the "dual accountability" environment.

Task 2: Officialize the GIS Governance Model

The City should review each of the Governance Model options in this chapter and select the one that makes the most sense for Irvine. Each of these will result in a GIS Division that is tasked with supporting and promoting GIS throughout the City.

Task 3: Annually Update the GIS Strategic Plan

The GIS Strategic Plan should be updated annually. The City's roles, vision, and functions constantly evolve. The GIS Plan should be updated to stay relevant to Irvine's vision, goals, and objectives, as well as the practical aspects of implementation.

Task 4: Adopt a GIS Vision, Goals, and Objectives

The larger vision of the City must be broken down into concrete goals. The vision, goals, and objectives of GIS technology must align with the City's vision and have measurable objectives. The City should update its visions, goals, and objects to align with the evolving GIS.

Task 5: Formalize a GIS User's Group

A GIS user group is a cohort of stakeholders who share information and compare experiences with GIS technology for the benefit of all members. The proposed GIS Supervisor in coordination with the Steering Committee should identify who participates in the GIS User Group and develop a strategy for the GIS User Groups goals and objectives.

Task 6: GIS Policy and Mandates

Policies refer to procedural codes of conduct that are ratified and enforced by organizational authorities. The City should establish a set of standards and procedures for the development and maintenance of geospatial data including Office-to-Field--Field-to-Office procedures,

GPS Quality Standards, Versioning, Digital Submission Standards, Cartographic Standards, and GIS Business Integration. These standards need to be followed by staff as they create and edit GIS data.

Task 7: Measure the Quality of Service

Measuring quality of service refers to the City's capacity to gather feedback data about the efficacy of its geospatial technologies. The GIS Supervisor should measure satisfaction levels annually using an online questionnaire and feedback at User Group meetings. This should be reported to the Steering Committee.

Task 8: Identify GIS Authority and Clear Lines of Responsibility

A line of responsibility describes the vertical chain of liability and authority in the City. In common-sense terms, a line of responsibility formally lays out who is responsible for what and to whom. The City should create clear roles and responsibilities, notifying all GIS users of those roles and responsibilities. The roles and responsibilities outlined in this plan should be reviewed with all key departments.

Task 9: Develop an Annual Detailed GIS Work Plan

A work plan proposes the schedule and budgeting for a specific project. The work plan associated with a GIS initiative should be updated on an annual basis to reflect the evolving needs and priorities of a GIS enterprise organization. The GIS Supervisor should create and maintain an annual GIS work plan that details all departmental support.

Task 10: Nurture a Culture of Collaboration Among Stakeholders

A culture of collaboration refers to an attitude that is expressed by stakeholders in their relationships to one another, as it pertains to an enterprise GIS. The GIS Division should focus on enabling and nurturing a culture of collaboration among stakeholders. The GIS Team should review the Characteristics of a Good GIS Manager/Team in this document annually and do a self-evaluation.

Task 11: Alignment with City's Overall Vision, Goals, and Objectives (Resilience Strategy)

The enterprise GIS needs to be aligned with the City's vision, goals, and objectives. The GIS Supervisor should review the City's overall mission, goals, and objectives annually and with the idea of trying to align the GIS accordingly. This should manifest itself as an annual alignment report.

Task 12: Consider an Additional GIS Specialist

As this GIS plan is executed, it is anticipated that the demand for GIS will increase as will the plethora of applications and data. This will require additional resources. The annual work plan and metrics will assist in determining when and if this new resource is needed. It is anticipated that in year three of this plan that the workload will merit the additional staff resource.

Task 13: Create an Annual Training Plan

It is critical to have a plan for formal education. An annual training and education plan should be created and feed into the annual work plan.

Task 14: Create an Annual Communication Plan

As important as the training plan, is a communication plan. This chapter identifies a number of communication recommendations. These should be included in a communication plan. This is one of the most important components of advancing GIS at Irvine. Promoting the GIS is important and should become a priority. Documenting successes and sharing them with the organization should become standard practice. Developing a mindset of quantifying how GIS is benefitting the organization should be cultivated.

Task 15: Create a Succession Plan

Create a plan to ensure that key knowledge is captured via SOPs and ensuring that there is cross-training in case of the loss or absence of a key person.

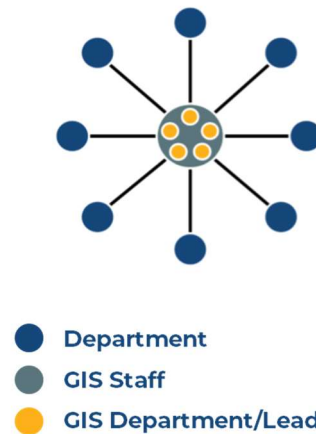
Task 16: Include Project Managers in the GIS Program

The CIO has introduced Technical Project Managers as key liaisons with the departments. The GIS Supervisor should meet with the Project Managers regularly to discuss department needs and how GIS can assist in enabling the departments.

Appendix 1 - Enterprise-Wide Organizational Models

There are three primary organizational structures (centralized, decentralized, and hybrid) used to implement enterprise-wide GIS within organizations throughout North America. The first type is a **centralized** structure. A centralized organizational structure maintains a central department or division that is responsible for all GIS services. In this type of structure, GIS often has its own dedicated department or is a division of an Information Technology (IT) or GIS using department. The GIS department/division employs a cadre of management, analysts, technicians, and programmers tasked with hardware, software, application development, planning, and training. Data are created and maintained by this group, or outsourced to contractors. All other participants are characterized as end-users, with primarily the capability to view, query, and analyze spatial data. However, with the advent of a new set of easy-to-use data collection tools and applications, end-users in some cases will be contributing to data creation and data maintenance.

Centralized GIS Organizational Structure



Business units or departments use the data for day-to-day operations or detailed analysis. Feedback is channeled through the chain-of-command to the lead GIS staff person/s. In some cases, oversight comes from a steering committee and end-user groups. Bureaucracy and duplication of effort are minimized since there are a central command and control and a single budget source. GIS functions are split into teams that are responsible for each function and requests for services.

The major strength of the centralized model is a well-structured and defined universal GIS system that is highly efficient and effective for the entire enterprise. The weakness of this model is that it can become too rigid or inflexible for stakeholders. If this model is used, Irvine could benefit from a well-run efficient machine with few redundant processes, but the

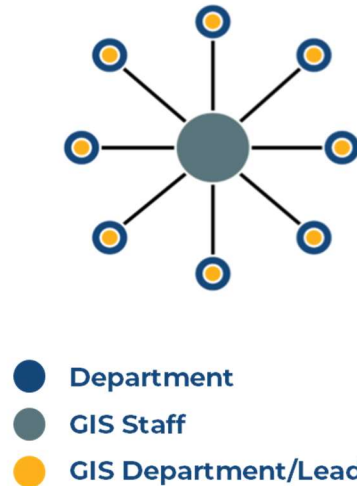
City must be careful not to isolate stakeholders. Many cities usually shy away from the centralized model, since it has a comparatively higher start-up cost than the other models. Additionally, this model does not engage the subject matter experts within the department thus limiting the collective knowledge base and buy-in.

The second type of model for GIS governance is a **decentralized** structure. A decentralized organizational structure divides GIS responsibilities throughout various departments. Decentralized organizational structures may still have a GIS section/division, operating independently or under the jurisdiction of another department. This approach divides system and data maintenance between the GIS section/division and departmental end-users. During their course of daily

business, users update an enterprise database (e.g., using ArcGIS to edit data). All users share responsibility for maintaining the GIS, and users within each department maintain specific data according to their thematic disciplines and specialties. This type of organizational structure enables the GIS section/division to focus on hardware and software maintenance, data exchange and distribution, application/data design and development, user training and support, community extension, and technology innovation, instead of devoting time to the creation and maintenance of data. In this model, no person or group is governing or ultimately responsible for GIS. This may result in a number of GIS technologies and processes.

The benefit of a decentralized model is a defined structure where stakeholders pool their resources and work together to build a GIS. The model is flexible and ensures that stakeholder needs are addressed. However, the risk is that it can become difficult to coordinate and negotiate, as Irvine has seen. It requires strong communications and leadership to hold the system together. Redundant data capture, staff, funding, and initiatives often occur in this model. The City would need to be aware and implement many teams and committees to serve as a check and balance to the divergent needs.

Decentralized GIS Organizational Structure



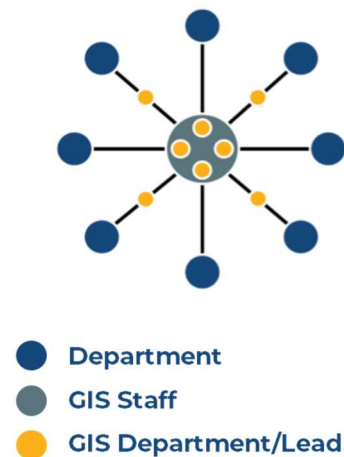
Many local governments utilize a **hybrid** GIS organizational structure, based on centralized and decentralized organizational models. This type of structure provides the benefits of both organizational models in scenarios where the full implementation of either organizational structure cannot be readily attained.

The major benefit of the Hybrid model is its flexibility. Stakeholders actively participate in the design and project planning stages. Stakeholders work together while dividing and sharing GIS functions. The GIS central body is responsible for the overall professional direction, career development, GIS system architecture, applications, license pools, and delegating project work. The intra-departmental stakeholder teams are responsible for data capture, data edits, quality control, and cartographic output. Stakeholders pool resources and cross-train team members from different departments.

Redundancy is reduced since there is a central command structure made up of a lead GIS staff person (GIS Supervisor) and key GIS technical staff. Flexibility and departmental expertise are ensured, since the stakeholder teams' work within the departmental structure on specific end-user functions. If funding or leadership is lacking in a single department then the other departments compensate. Smaller departments are involved since they have an equal share in the decision-making process and they are supported by intra-departmental teams.

The Hybrid model risk is that if there is no clear direction and agreement among participants concerning roles and responsibilities, it may devolve into the decentralized model and redundant processes will emerge. There is a risk that too many formal agreements and formal meetings will make decision making confusing and hamper productivity. People may not understand the system and may make up their own systems just to be functional. Strong communication, GIS knowledge, and leadership are required to make it run. Irvine would

Hybrid GIS Organizational Structure



benefit from the Hybrid model since it is a mature system with competent and well-educated professional GIS staff. Irvine would see an immediate return if this model was adopted.

DEFINITIONS SUMMARY OF ORGANIZATIONAL STRUCTURES

▶ **Centralized Organizational Structure:**

All GIS tasks, except data viewing and analysis, are handled by a central GIS department or division. All GIS staff are located within the central GIS department or division.

▶ **Decentralized Organizational Structure:**

GIS data updating and maintenance responsibilities are assigned to individual GIS-participating departments. Departments have their own GIS staff members.

▶ **Hybrid Organizational Structure:**

GIS tasks may be handled centrally or at the department level, depending on the needs and available GIS staff at individual departments.

Strategic Implementation Plan

City of Irvine | CA

table of
CONTENTS

Introduction..... 1
Alignment With City Goals and Objectives..... 2

 Irvine Strategic Priorities4
 Alignment Conclusion8

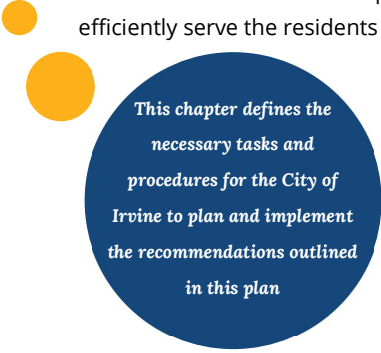
Five Year Tactical Plan 9

 Strategic Plan9

Strategic Plan of Action Schedule..... 31
Ten Year Forecast of Trends..... 35
Conclusion 39

Introduction

This chapter focuses on an implementation plan for implementing the key elements that have been identified and detailed throughout this plan. The overall Enterprise Master Plan for GIS is designed to identify the necessary actions and steps to advance GIS throughout the organization. GIS will impact the organization as a whole, as each department will rely on GIS data and applications for visualizing and decision-making. Overall, the desired result is to utilize GIS as an enterprise-wide tool, which enables staff to more effectively and efficiently serve the residents of the City of Irvine.



This chapter defines the necessary tasks and procedures for the City of Irvine to plan and implement the recommendations outlined in this plan

This chapter defines the necessary tasks and procedures for the City of Irvine to plan and implement the recommendations outlined in this plan. This five-year phased master plan, if implemented, will provide the City of Irvine with a cost-effective solution that allows the City to further utilize GIS in an enterprise-wide fashion.

Alignment With City Goals and Objectives

Often, local government GIS staff focuses on short-term technology-related issues. This can result in goals that are myopic and only consider the specific needs of the users without considering how these goals align with the overall goals of the organization. This leads to the GIS program being seen as a niche technology- important for the day-to-day activities of an organization but not seen as instrumental in achieving corporate goals. GIS staff is often in an Information Technology Department and around other technologists. Typically, they are not involved in high-level organizational decision-making. This tends to result in staff that is unaware of the issues that are most important to department heads, the public, and the elected officials. This is a mistake.

Every organization has competing interests. Those programs that are deemed most important and indispensable are always given priority and well-funded. Niche programs are vulnerable to downsizing, budget cuts, and in extreme cases elimination. Local government GIS programs exist on both sides of this spectrum. Some organizations have done a great job educating the organization and organizational leaders about the way GIS is and can be used to support critical functions of the organization - others have not. Understanding and visibility of any program is important.



GIS has a strategic advantage in that regard. Some programs are limited in scope and focus on a narrow set of needs. If the need for this type of program dissipates then the program is in jeopardy. However, a GIS program has many aspects that can uniquely elevate it within the organization as follows:

- GIS can and should support the functions of all departments – enterprise-wide technology;
- GIS can produce results that are graphically pleasing and readily understood;
- GIS assimilates and presents diverse data in ways that no other technology can;

- GIS adds a large amount of value to existing IT systems that organizations have spent millions on;
- GIS has a diverse amount of return-on-investment possibilities;
- It has been said that 95% of local government data has a geographic component. GIS is the way to display and analyze that data;
- GIS can be a key technology to share data with the public.

These factors and many others should make GIS indispensable and highly visible in every municipal organization. However, this is often not the case. As aforementioned, GIS can be relegated to a niche technology. This is often the result of lack of education, lack of visibility, and lack of corporate alignment. The following is a list of contributors to the failure or lack of success for municipal GIS implementations:

- Technology focus not solution focus;
- Not quantifying alignment and impact on the organization;
- Not knowing what the City goals are;
- Not talking the language of management;
- Allowing GIS to be seen as another software product instead of an enterprise-wide program;
- Not educating the organization on the organization-wide impact of GIS;
- Not leveraging GIS as the window into all of the city's technology (other IT systems);
- Not publicizing successes.

Each of the above leads to nonalignment of GIS with the organization. This non-alignment can result in the following:

- Program shifting from one department to another;

Strategic Implementation Plan
City of Irvine | CA

- Misunderstanding of what the technology can and should be doing for the organization;
- Lack of funding;
- Program discontinuance;
- Departments not using the technology;
- Small amounts of users;
- Users relying on IT staff to do all GIS work;
- Non-integration with IT systems;
- Not being brought to the table to solve city-wide problems and challenges;
- Not being conferred with as new systems are acquired.

Irvine's existing GIS can be considered very successful in a variety of ways. However, for the program to reach its potential and have the biggest impact, it must align with organization-wide goals and assist in achieving these goals. This is not a one-time alignment but a continual examination of the program. A review of the City's website and FY 2019-21 Budget identifies Irvine's Strategic Priorities. Most of these priorities can be impacted by GIS.

Irvine Strategic Priorities

Along with City staff, the Irvine City Council examines the challenges, needs, and priorities of the community. These City of Irvine Strategic Priorities are the overarching goals that will guide the city for the long-term. These Strategic Priorities are supported in Irvine's daily functions and in the budget. It is important that the GIS Team understand and review these goals in light of how GIS can be used to assist in achieving these priorities. The following is a review of the priorities and the current and potential alignment. Key Strategic Priorities that are readily supported by GIS are as follows:

- Maintain High-Quality Essential City Services
- Enhance Citywide Mobility Through Transportation Improvements

- Promote Innovation Through the Effective Use of Information Technology Solutions to Streamline Business Processes and Increase Responsiveness to the Community



For the City to achieve goals related to these priorities a variety of tools will be required. GIS is the logical tool to manage, visualize, and make decisions that affect these priorities. GIS allows for internal and external visualize of data, concepts, and ideas. The platform is perfect for data, information, and idea dissemination, and for collaboration with the community. The following are just a few specific ways GIS will help achieve the goals set forth within the strategy:

- **Maintain High-Quality Essential City Services** – Approximately 95% of every service at any city has a geographic component (address, parcel location, route). Therefore, if the City of Irvine is to maintain quality essential services it is imperative that staff and residents can visualize key data in a geographic context. For example; What/where are the services offered in Great Park?, Where are our parks and what are the amenities?, Where are crimes occurring in the city and how best can we deploy our resources? Where are the Child Care facilities and where is the demand?, Where is our infrastructure and where do repairs need to take place proactively? This plan has identified a number of GIS services current/planned/recommended that directly impact the City's ability to deliver on this strategy as follows:

- **Capital Improvement Projects** – GIS is essential for tracking all infrastructure and capital projects. Every department should have access to GIS for viewing the disposition of all projects. Additionally, the public should be provided map viewing portals to understand key elements and locations of all City projects.
- **Crime Analysis** – The Police Department relies heavily on visualizing and analyzing the location of all incidents in the City. This allows for proactive policing and ensuring that Irvine remains a safe place to reside and conduct business. Without GIS crime analytics, pattern analysis, and proactive policing would not be possible. Additionally, residents are provided a map portal so that they can view and understand incidents anywhere in the City.
- **Parks** – Great Park and the other City parks each have their own unique characteristics. It is critical that the City map, track, and manage the parks and their assets with GIS. Additionally, this plan recommended a suite of applications that allow residents to understand and visualize park assets in a user-friendly way.
- **Emergency Operations** – Emergency events are inherently geographic in nature. Staff and residents need good location-based information for planning before an event, response during and event, and recovery after an event. GIS is mandatory to achieve a safe city. Emergency Operations needs a GIS-based common operational picture, GIS data collection tools for post-disaster assessments, public-facing tools to communicate with residents, and GIS tools to plan for future events.
- **Enhance Citywide Mobility Through Transportation Improvements** – Any good transportation system is tied to modern geospatial (GIS) systems. First Irvine must understand where all transportation assets are location (signals, roads, sidewalks, trails, striping, signs, etc.). Public Works and Transportation are heavy users of GIS with a priority on mapping infrastructure in GIS and using GIS for decision-making and visualization. GIS is or will be used to support this strategy are as follows:
 - **Transportation Mapping** – GIS to map all projects, roads, signals, sidewalks, rights-of-way, traffic, striping, and other transportation features.
 - **Street Improvements** – GIS is critical for managing pavement, paving priorities, and other street improvements.

- **Transportation Analysis** – GIS is mandatory for transportation forecasting and analysis.
- **Public Outreach** – GIS is currently used to share key data with the public to include street improvement plans, road construction, and bikeways.
- **Promote Innovation Through the Effective Use of Information Technology Solutions to Streamline Business Processes and Increase Responsiveness to the Community** – One of the strengths of GIS is the enablement of staff and the public with more and better information. This plan identified dozens of applications that are designed to improve business process and community responsiveness to include:
 - **Innovative Geospatial Hub** – an application suite that serves as a geospatial information hub providing key data to all city staff and the public;
 - **Great Park Virtual Tour** – an application that identifies all key assets of Great Park with navigation, way-finding, reservation capabilities, 3D capabilities, and other insight;
 - **Smart Urban Area Technology** – Using smart devices (traffic volume and flow, park usage, public safety-related devices) to gather key metrics and activities from around the City to become more proactive;
 - **Irvine Green** – an application to promote a variety of green initiatives at the City to include food waste preservation, recycling, solar feasibility, and green cover;
 - **My Government Services** - an application that allows users to quickly identify a list of services and amenities available to them;
 - **City-Wide Project Tracker** – enables staff and residents with the information about the projects the city is conducting in their area (past, present, and future).
 - **Promoting Recreational Opportunities** – Public-facing map that will allow the public to view recreational facility locations (including textual descriptions, photos, videos, and audio) and their associated amenities including ball fields, pools, pavilions, courts, etc.

Alignment Conclusion

Overall, the City GIS team has created data and implemented tools that assist departments in aligning with the priorities of the City. However, with the ever-advancing technology, many opportunities remain. New GIS tools have recently been released from Esri that should be fully leveraged to assist in meeting the City's priorities. It is highly recommended that the City GIS team create a GIS Alignment Plan Report each year to document how GIS currently aligns with Council priorities and a plan on how to further align and support these priorities over the coming year. This alignment section is used in conjunction with the findings from the Needs Assessments to develop a list of actionable enterprise-wide items with priorities.

Five Year Tactical Plan

The table beginning on page 22 documents all of the elements needed to further advance enterprise-wide GIS over a five-year period. A key focus is on the expansion of the user base with Internet, intranet, and targeted applications. An early primary objective is to gain several “quick successes” in terms of application implementation, data development and integration, data maintenance procedures, and education. A goal of Irvine should be following this systematic plan to become a recognized leader in the region. The City should seek awards from Esri and URISA. Also, in 2020 there will be a new organizational certification that the City should pursue.

Strategic Plan

The following plan identifies each activity and expense that has been identified throughout this plan. Each activity is divided into descriptive columns as follows:

Task – a descriptive title of the item

Department – the department that was identified to have a need for the item

Task Type


- OT = one-time non-repeating task
- MT = task that will be repeated multiple times
- OG = task that is ongoing
- D = department/division task funded by the departments as needed

Notes – comments and/or notes about the item

Year 1 – Year 5 Cost or Time – cost approximation of the item or time needed for implementation. Some items have numbers that are exact. Others will depend heavily on what type of technology is used to implement them. Some will require an RFP to determine the actual cost, although a best estimate has been given based on industry knowledge. Many of the recommended tasks will be done by internal staff or external consultants.




Master Plan Tasks

The following are each of the master plan tasks by major category, a brief description, and any task dependencies.

 Denotes a task with dependency.

 Denotes an official decision point.

Category 1 - Governance

- **Consider a GIS Steering Committee** –  GIS Steering Committee should be considered based on recommendations beginning on page 25 of the Governance Chapter. GIS Steering Committee will guide GIS priorities. See Governance Chapter page 25.
- **Expand the Technical Project Manager Practice to GIS** – PMs meet regularly with the GIS Supervisor to integrate the findings of this report and get feedback about the geospatial activities in the various departments.
- **Annual User Survey** - Annual user satisfaction and input survey. Measure sensitivity to user needs.
- **GIS Users Group** – A GIS Users group should be formed and meet quarterly.
- **Annual Return on Investment and Alignment Analysis** - Annual analysis of work conducted and impact on organization *Data gathered during the annual user survey* 
- **Annual Update to the GIS Strategic Plan** – Document successes, priorities, and adjust budget where needed.
- **Create and Adopt a GIS Vision, Goals and Objectives** – GIS Vision, Goals, and Objectives should align with the City's vision and have measurable objectives.
- **Annual Review of Goals and Objectives** – Ensure they align with the City Council's goals. The starting point for this has been documented earlier in this chapter. *Must complete vision, goals, and objectives in year one.* 

- **Develop an Annual Work Plan** - A work plan proposes the schedule and budgeting for a specific project. The work plan associated with a GIS initiative should be updated on an annual basis to reflect the evolving needs and priorities of a GIS enterprise organization. The GIS Supervisor should create and maintain an annual GIS work plan that details all departmental support.
- **Develop a Training and Education Plan** - As a companion document to the annual work plan, the GIS team should create and update an annual training and education plan based on the information in the Organization Readiness document. Technology changes continuously and the plan should reflect the changing technology and the needs of the organization.
- **Form a Geospatial Customer Engagement Team** - this team will ensure that the plethora of public-facing applications recommended in this report are consistent and meet City standards. See Page 31 of the Needs Assessment document.
- **Improve Addressing Process** - To ensure timeliness and completeness. See pages 35 and 36 of the needs assessment.

Category 2 - Infrastructure

- Review and implement GIS architecture design as identified in this plan to enable ROI from a full ArcGIS Enterprise implementation (as per the Infrastructure Chapter):
 - Implement a more robust staging (testing) environment
 - The staging environment be modified to mirror the production environment.
 - Refactor the production environment to more effectively isolate the various system roles as documented in the Technology Readiness Chapter
 - Deploying a second ArcGIS Server to the existing GIS site to provide greater availability, to reduce downtime, and to allow for easier management and administration of the external production environment
- **Ensure big data readiness** - In preparation for the City of Irvine developing and deploying real-time, big-data the City should perform load and network capacity tests against high velocity, high volume, and high variety data streams.

Strategic Implementation Plan
City of Irvine | CA

- **Optimize web content generation** - Implement a structured approach to service management and web content generation to prevent overwhelming the server through redundant/unnecessary service creation. Review the following annually:
 - As a general rule, your deployment should have no more than ten (10) map service instances running per CPU core on the ArcGIS for Server machine.
 - An ArcGIS Enterprise site should have no more than two hundred service instances per site. This is to prevent encountering an operating system level limitation.
- Create domain certificates and apply to all machines to fully support HTTPS traffic across all levels of the GIS
- Regular updates to the most recent patch release of the ArcGIS Enterprise platform.
- Review and Maximize ArcGIS Enterprise Performance – Employ techniques (e.g. process configuration, cached map services, memory configuration) to ensure maximum performance of ArcGIS Enterprise. Regular and structured procedures be established to maintain optimal database performances, such as rebuilding statistics, rebuilding indexes, database compression, and regular load-testing. These processes coupled with thoughtful table and data design can vastly improve database performance.
- Optimize servers as needed:
 - Based on the CPT System Design results and following industry best practices, the following server resources are recommended to support the City's GIS users in the City's production environment:
 - Database: 16 GB of RAM // 8 Cores – Per DB Server
 - Application Tier: 72 GB of RAM // 16 Cores – Across Application Tier
 - Web Tier: Normal Specs 8 GB RAM // 2 Cores – Per Web Server
 - Review and update these specifications annually
- **Implement role-based security** - Implement and use role-based security at the database level to both simplify and more tightly secure their data resources.

- **SAN storage for SQL Server** - It is recommended that the organization leverage SAN storage for its SQL Server implementations rather than using local storage for its benefits of stability, limited performance consequences, and its ability to be expanded.
- **Review and optimize imagery storage** - GTG recommends that imagery being consumed as a basemap or a contextual layer be published as a cached map service to ArcGIS Enterprise. Caching your imagery provides performance and storage benefits and is industry best practice.

Category 3 – Maintenance












- **Esri Software** – Core GIS software for the enterprise. Current maintenance pricing.
- **Two Copies of Community Analyst** – Annual Fee
- **ArcGIS Hub Premium** – Annual Fee years 2-5
- **Data Mining Middle Ware** - Maintenance years 2-5
- **ArcGIS Urban** – Maintenance years 3-5
- **Additional Seat of Spatial Analyst** - Maintenance years 2-5
- **Data Reviewer** - Maintenance years 2-5
- **Drone2Map** – Maintenance years 3-5

Commented [MS1]: We contract out for drone data collection.

Category 4 – Training and Education

Training and Education needs are staff dependent. Some staff need courses that other do not. The governance section earlier recommended an annual training and education plan. The below courses should be included in the annual training and education plan. As technology changes, different courses will need to be added to augment the plan.

Strategic Implementation Plan
City of Irvine | CA

- **Annual Training for GIS Team** – The GIS team should have an annual budget to accommodate the classes listed below as needed and in accordance with the annual training plan.
- **Annual Training Budget for Onsite Training** - Training budget to have specialist on-site to train staff throughout the City. The GIS team can do some internal training but funds are needed for augmentation.
- **ArcGIS 1: Introduction to GIS**
- **ArcGIS 2: Essential Workflows**  *ArcGIS 1 or have commensurate skills*
- **ArcGIS 3: Performing Analysis**  *ArcGIS 1 and 2 or have commensurate skills*
- **ArcGIS 4: Sharing Content on the Web**  *ArcGIS 1 or have commensurate skills*
- **Creating and Editing Data with ArcGIS Pro**  *ArcGIS 1 and 2 or have commensurate skills*
- **Deploying and Maintaining a Multiuser Geodatabase**  *ArcGIS 2 or have commensurate skills*
- **System Architecture Design Strategies**  *Review Esri's System Design Wiki Site*
- **Putting ArcGIS to Use Across Your Organization**  *ArcGIS 1 or have commensurate skills*
- **ArcGIS Pro: Essential Workflows**  *ArcGIS 1 or have commensurate skills*
- **Migrating from ArcMap to ArcGIS Pro**  *ArcGIS Pro Essential Workflows or have commensurate skills*
- **Sharing GIS Content Using ArcGIS**  *ArcGIS Pro: Essential Workflows OR Migrating from ArcMap to ArcGIS Pro or have commensurate skills*
- **Configuring Web Apps Using Web AppBuilder for ArcGIS**  *Creating and Sharing GIS Content with ArcGIS Online*
- **Field Data Collection and Management Using ArcGIS**
- **Tier 3 Applications** – Conducted by GIS Team

Commented [MS2]: Questioning the need for ArcGIS training. We're in a state of transition to ArcGIS Pro and only fall back to ArcGIS when functionality isn't available in Pro.

- **Web Courses**
 - Getting Started with GIS
 - Referencing Data to Real-World Locations using ArcGIS
 - Finding Geographic Data in ArcGIS
 - Solving Spatial Problems Using ArcGIS
 - Creating and Sharing GIS Content using ArcGIS Online
- **Regional and National Conferences/Workshops** – See pages 57 – 59 of the organizational readiness plan.
- **Communication Strategy** – The following are items not addressed in the previous sections:
 - **GIS User’s Group** – Quarterly meeting for GIS users
 - **GIS Day** – November of every year
 - **Annual User Satisfaction Survey and Report** – Anonymous survey for candid feedback
 - **One-on-one Meetings** – Monthly meetings with key decision-makers and department heads
 - **Executive Presentations** – Highlighting the benefits of GIS throughout the organization
 - **Implementation of Blogs, Email and Social Media** – For communications
 - **Newspapers and Television** – Share exciting GIS projects with the media
 - **Brochures, newsletters, and other marketing efforts** – Market success and services
 - **Seminars** – Throughout the year

Category 5 – Data, Databases, and Consulting

- **Develop, formalize, and enforce standardized GIS data creation procedures across the enterprise** - Establish and enforce procedures that will add consistency to data creation.
- **Acquire/develop all desired layers based on needs assessments** - Obtain recommended layers from other government sources, create internally, or create with the use of consultants. Departments will need to consider funding the creation and/or augmentation of needed data. The GIS Team will consult with departments annually to discuss needed GIS layers and methods for creation/augmentation.
- **Officialize Data Governance Strategy and Implement a Data Management Program** – As per pages 8 – 13 of the Enterprise Data Management Strategy and Program Chapter.
- **Implement Address Point Layer Improvements and Master Address Database** – as per pages 19 – 23 of the Enterprise Data Management Strategy and Program Chapter.
- **Implement Street Centerline Changes** – as per pages 23 and 24 of the Enterprise Data Management Strategy and Program Chapter.
- **GIS Consulting Services** – Annual fund to utilize outside expertise on an as-needed basis. There are a well over 100 data and technology recommendations in this plan. Existing staff do not have the time to implement them all. Therefore, it is recommended to use a consulting firm/s to assist with the implementation and maintenance of many of these recommended solutions.
- **Data Mining** – Using a data mining software package, systematically begin data mining from each of the existing IT systems used by the departments including OnBase, GoEnforce, HostCompliance, Progressive, Eden, Central Square, CivicRec, Lucity, Chamelon, and others. This will require extensive knowledge of SQL/Oracle nomenclature and the data mining tool. As per pages 26-29 of the Enterprise Data Management Strategy and Program Chapter.
- **Master Data List** – Actions as outlined on pages 31-35 of the Enterprise Data Management Strategy and Program Chapter.

Commented [MS3]: Any recommendations on data mining software packages?

- Form a sub-committee to review metadata and the MDL. Meet as needed. Include staff from other departments.
- Creation of a user-friendly Master Data List (Hardcopy and Digital)
- Annual MDL and Metadata workshop
- MDL tutorial video
- Annual user survey and feedback on the MDL
- **Implement ArcGIS for Local Government** – Review and deploy targeted ArcGIS for Local Government applications.
- **Database Design, Development, and Cleanup** – ▲ It is recommended that the City review its geodatabase design and consider migrating to a standardized model such as the Local Government Information Model (LGIM) where possible. A consultant can be used to assist with this process. Summary of actions items on page 63 of the Enterprise Data Management Strategy and Program Chapter.
- **Digital Data Assessment** – Use ArcGIS Data Reviewer annually on key data sets to find potential issues. It is recommended to use a consultant in the first year to do a digital data assessment of all layers.
- **Metadata**
 - **Metadata Policy and Standards** – Establish metadata template, data to be populated, and policies for an update.
 - **Implement and Populate Metadata** – Implement metadata as described in the previous step. ↻ *Template must be decided upon*

Category 6 - Software

- Public-Facing Applications
 - **Implement ArcGIS Hub Premium** – The GIS team in tandem with a consultant should implement a fully deployed ArcGIS Hub Premium site. ArcGIS Hub

Strategic Implementation Plan
City of Irvine | CA

Premium comes with Initiatives that will engage the public and require interaction and commitment from the City.

- **Home Ownership Associations (HOAs) Story Map for Community Development** – make residents aware of HOAs, contact information and ability to sign up for leadership.
- **General Plan Story Map** – Living Document Story Map that shares the highlights of the City's General Plan.
- **Great Park Virtual Tour** – Either a series of embedded story maps and apps or a custom application that showcases Great Park to include: Navigation, Way finding, All facilities, Reservable facilities, Schedules, 3D view of buildings and stadium, and other key features.
- **Irvine Green** – Story map that highlights the City's green initiatives (food waste prevention, recycling facilities and programs, solar feasibility, and green cover).
- **Transportation Plans** – Living document story map to show key elements of the various transportation plans (ETA, SCAG, OCA, Bike Plans, etc.).
- **Internal Public Safety Story Map for Crime Briefings** – Highlighting key trends and activities.
- **Meet the Officer Story Map** – Story map telling the story of the Police Department to include introducing patrol officers.
- **National Night Out Story Map** – Highlighting key events and elements of the National Night Out.
- **Cold Case Story Map** – Highlighting cold cases.
- **Automated Data Mining Middleware Software** – Software product to automate data mining from the existing IT systems (OnBase ECM ,Eden, Progressive Solutions, Infor Gold , Central Square, CivicRec, Lucity, etc.).
- **Implement Esri Web AppBuilder** – The GIS Team and consultant should implement Esri Web AppBuilder tailored to various department groups. Specific instances for:
 - Police

- Public Works
- Planning
- **Implement Operations Dashboard for Police** - View key metrics with live mapping.
- **Implement Operations Dashboard for Public Works** – Key metrics about infrastructure and projects.
- **Implement Portal for ArcGIS** – Eliminates the need to login for any of the Esri ArcGIS Online applications. Portal allows users to share maps, applications, and other geographic data with the organization.
- **Migrate to ArcGIS Pro** – Irvine will need to systematically move to ArcGIS Pro as the latest desktop software from Esri.
- **Further Implement Collector and Survey123** – Various departments desired the ability to collect and view data in the field. Collector and Survey 123 should be further implemented as appropriate.
- **3D Visualization Software** – Irvine should acquire Esri’s City Engine and ArcGIS Urban as per pages 49-50 of the Needs Assessment chapter. Projects should be undertaken to showcase the capabilities of these software products.
- **Drone2Map** – Esri software to convert drone imagery to GIS data.
- **Expand the CIP Software Effort** – Include all pertinent departments in the maintenance of capital project information. This should include the Esri Capital Project Tracking application and Story Maps.
- **Additional Copy of Spatial Analyst** – for Police
- **Map Book software** – Scripts and Esri tools for creating map books for Public Safety
- **Emergency Operations Suite** – as per pages 61 – 65 of the needs assessment
 - Common Operational Picture
 - EOC Dashboard
 - Damage Assessment Tools

Commented [MS4]: We consider this a commodity and farm it out to others.

Strategic Implementation Plan
City of Irvine | CA

- Public Disaster Map
- Story Maps
 - Living document that shows key elements of the hazard mitigation plan
 - Emergency Operations Story Map showing critical facilities and emergency game plan
 - Post-disaster story map
- **Parks Suite (Great Parks and Community Services)** – as per pages 66 – 70 of the Needs Assessment
 - Parks Intranet Portal
 - Integration with CivicRec and Lucity
 - Park Locator
 - Esri Community Analyst
 - Parks Story Maps
 - Great Park Specific Application
- **Esri Community Analyst** – Two copies (CD and Parks).
- **Crowdsource Reporter and Manager** – feedback from the public.
- **My Government Services** – Configuration of Web AppBuilder.
- **Economic Development Suite** – as per pages 76 – 79 of the Needs Assessment
- **Acquire Esri Data Reviewer** – for annual data assessment

Commented [MS5]: What is this? We have created a “black site” that our City website gets switched to in case of a disaster. Is this the same or different?

It is important to note that the following strategic plan is not an all or nothing strategy. Depending on actual budget allocation, the plan can change and be reprioritized. Each of the items in the strategic plan were prioritized based on the extensive staff interview process, analysis of the system design chapters, and the criticality of items that are necessary for the success of other items. This document and strategic plan should be updated annually based on funding available and changing priorities. The entire plan should be redone in totality every five years. The following strategic plan has a criticality ranking (Ranking column in the



following chart). This will help the organization decide on priorities if there is a budget shortfall. The ranking is as follows:

- **A – Mandatory item.** Without this item other items cannot be accomplished and the project as a whole will be jeopardized.
- **B – Important item.** The program can still function in the near term if this item is delayed. However, the item is needed and should be considered a high priority.
- **C – Desired item.** This item is desired but if it is not implemented it will not adversely affect other items. In some cases, this is a departmental item and its importance is departmental.

The chart(s) on the next pages contains all of the 5-year plan items sorted by task type (Governance, Infrastructure, Maintenance, Services, Data, Software, and Training/Education). Estimated costs where shown **do not include wages and benefits for existing staff.**

Commented [MS6]: What do the letters in the Task Type column stand for?

In the following table:

-  Means existing expense
-  Means nothing occurs in this year

Five Year Tactical Plan of Action Schedule									
GOVERNANCE									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Consider a GIS Steering Committee	GIS Steering Committee	OG	A	GIS Steering Committee should be considered based on recommendations beginning on page 25 of the Governance Chapter. GIS Steering Committee will guide GIS priorities. See Governance Chapter page 25.	*	*	*	*	*
Expand the Technical Project Manager Practice to GIS	CIOs Office	OG	A	PMs meet regularly with the GIS Supervisor to integrate the findings of this report and get feedback about the geospatial activities in the various departments.	*	*	*	*	*
Annual User Survey	Enterprise GIS Manager	OG	B	Annual user satisfaction and input survey. Measure sensitivity to user needs.	*	*	*	*	*
GIS Users Group	All	OG	B	A GIS users group should be recommitted and meet quarterly. See the Governance Chapter.	*	*	*	*	*
Annual Return on Investment and Alignment Analysis	GIS Team	OG	B	Annual analysis of work conducted and impact on the organization. Review how GIS aligns with City Council and organizational goals.	*	*	*	*	*
Annual Update to the Strategic Plan	All	OG	A	Document successes, priorities, and budget.		\$10,000	\$10,000	\$10,000	\$10,000
Create and Adopt a GIS Vision, Goals and Objectives	GIS Team	OT	B	GIS Vision, Goals, and Objectives should align with the City's vision and have measurable objectives	*				
Annual Reivew of Goals and Objectives	GIS Team	OG	B	Ensure they align with the City Council's goals.	*	*	*	*	*
Develop an Annual Detailed GIS Work Plan	Enterprise GIS Supervisor	OG	A	The Enterprise GIS Manager should create and maintain an annual GIS work plan that details all departmental support.	*	*	*	*	*
Develop a Training and Education Plan	Enterprise GIS Supervisor	OG	A	As a companion document to the annual work plan, the GIS team should create and update an annual training and education plan based on the information in the Organization Readiness document. Technology changes continuously and the plan should reflect the changing technology and the needs of the organization.	*	*	*	*	*
Form a Geospatial Customer Engagement Team	Enterprise GIS Supervisor and Select Members from other Departments	OG	A	This team will ensure that the plethora of public-facing applications recommended in this report are consistent and meet City standards. See Page 31 of the Needs Assessment document.	*	*	*	*	*
Improve Addressing Process	GIS Team, PD, and Community Development. Others as Needed	OG	A	To ensure timeliness and completeness. See pages 35 and 36 of the needs assessment.	*				
Grand Total by Year for Governance - (* Does not include salaries for existing or recommended staff)					\$0	\$10,000	\$10,000	\$10,000	\$10,000

INFRASTRUCTURE									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Review and implement GIS architecture design improvements (as per the Infrastructure Chapter)	GIS Team in Coordination with IT Staff	OG	B	Implement a more robust staging (testing) environment (mirroring production environment). Refactor the production environment. Deploying a second ArcGIS Server to the existing GIS site to provide greater availability, to reduce downtime, and to allow for easier management and administration of the external production environment. Review every other year to ensure optimization.	*		*		*
Ensure big data readiness	GIS Team in Coordination with IT Staff	OG	C	In preparation for the City of Irvine developing and deploying real-time, big-data the City should perform load and network capacity tests against high velocity, high volume, and high variety data streams. Review and test every other year.		*		*	
Optimize web content generation	GIS Team in Coordination with IT Staff	OG	A	Implement a structured approach to service management and web content generation to prevent overwhelming the server through redundant/unnecessary service creation. (see implementation plan section for what to review annually). Review annually.	*	*	*	*	*
Create domain certificates and apply to all machines to fully support HTTPS traffic across all levels of the GIS	GIS Team in Coordination with IT Staff	OG	B	Ensure compliance with best practices.	*				
Regular updates to the most recent patch release of the ArcGIS Enterprise platform.	GIS Team in Coordination with IT Staff	OG	A	Review once a quarter and make it an ongoing task of one of the GIS Team.	*	*	*	*	*
Review and Maximize ArcGIS Enterprise Performance	GIS Team in Coordination with IT Staff	OG	A	Employ techniques (e.g. process configuration, cached map services, memory configuration) to ensure maximum performance of ArcGIS Enterprise. Regular and structured procedures be established to maintain optimal database performances, such as rebuilding statistics, rebuilding indexes, database compression, and regular load-testing. These processes coupled with thoughtful table and data design can vastly improve database performance. The City may consider a consultant for this taks. Establish and SOP and review quarterly or bi-yearly.	*	*	*	*	*
Optimize servers as needed	GIS Team in Coordination with IT Staff	OG	A	Based on the CPT System Design results and following industry best practices, there are server resources recommended to support the City's GIS users in the City's production environment in the implementation plan section above. Review annually.	*	*	*	*	*
Implement role based security	GIS Team in Coordination with IT Staff	OT	B	Implement and use role-based security at the database level to both simplify and more tightly secure their data resources.	*				
SAN storage for SQL Server	GIS Team in Coordination with IT Staff	OT	B	It is recommended that the organization leverage SAN storage for its SQL Server implementations rather than using local storage for its benefits of stability, limited performance consequences, and its ability to be expanded.	*				

INFRASTRUCTURE (Continued)									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Review and optimize imagery storage	GIS Team	OG	A	GTG recommends that imagery being consumed as a basemap or a contextual layer be published as a cached map service to ArcGIS Enterprise. Caching your imagery provides performance and storage benefits and is industry best practice.	*	*	*	*	*
Grand Total by Year for Infrastructure					\$0	\$0	\$0	\$0	\$0
MAINTENANCE									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Esri Software	GIS Team	OG	A	Core GIS software for the enterprise. Current maintenance pricing.	\$39,900	\$39,900	\$39,900	\$39,900	\$39,900
Two Copies of Community Analyst	CD and Parks	OG	B	Annual Fee for CD and Parks	\$200	\$200	\$200	\$200	\$200
ArcGIS Hub Premium	GIS Team	OG	B	Annual Fee implement in Year Two		\$10,000	\$10,000	\$10,000	\$10,000
Data Mining Middle Ware	GIS Team	OG	A	Maintenance years 2-5		\$2,500	\$2,500	\$2,500	\$2,500
ArcGIS Urban	GIS Team	OG	B	Includes City Engine - Years 2-5 (One Seat)		\$3,000	\$3,000	\$3,000	\$3,000
Additional Seat of Spatial Analyst	Police Department	OG	A	Maintenance years 2-5		\$800	\$800	\$800	\$800
Data Reviewer	GIS Team	OG	A	Maintenance years 2-5		\$800	\$800	\$800	\$800
Drone2Map	GIS Team	OG	C	Annual Fee years 3-5			\$1,500	\$1,500	\$1,500
Grand Total by Year for Maintenance					\$40,100	\$57,200	\$58,700	\$58,700	\$58,700
TRAINING AND EDUCATION									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Annual Training Budget for GIS Team	GIS Team	OG	A	In accordance with the annual training plan, the GIS Team should take the courses that best agument their skill set.	\$25,000	\$20,000	\$20,000	\$20,000	\$20,000
Annual Training Budget for Onsite Training	All	OG	A	Training budget to have specialist on-site to train staff throughout the City. The GIS team can do some internal training but funds are needed for augmentation.	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
ArcGIS I- Introduction to GIS	Tier One and Tier Two Users	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
ArcGIS Desktop II – Essential Workflows	Tier One and Tier Two Users	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
ArcGIS Desktop III - Performing Analysis	Tier One and Tier Two Users	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
ArcGIS IV – Sharing Content on the Web	GIS Manager and GIS Team	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
Creating and Editing Data with ArcGIS Pro	Tier One and Tier Two Users	OT	A	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed

TRAINING AND EDUCATION (Continued)									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Deploying and Maintaining Multiuser Geodatabases	GIS Database Designers and Administrators	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
System Architecture Design Strategies	GIS Manager and GIS Team	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
ArcGIS Enterprise: Configuring a Base Deployment	System Administrators	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
Developing Web Apps with ArcGIS API for JavaScript	GIS Team	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
Putting ArcGIS to Use Across Your Organization	GIS Team	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
ArcGIS Pro: Essential Workflows	GIS Team	OT	A	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
Migrating from ArcMap to ArcGIS Pro	GIS Team	OT	A	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
Sharing GIS Content Using ArcGIS	GIS Team	OT	B	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
Configuring Web Apps Using the Web AppBuilder for ArcGIS	GIS Team	OT	A	See the Training Chapter for more information related to each class.	as needed	as needed	as needed	as needed	as needed
Field Data Collection and Management Using ArcGIS	Class taken by one of GIS team and then taught annually to key field collectors	OG	A	See the Training Chapter for more information related to each class.	At least once a year	At least once a year	At least once a year	At least once a year	At least once a year
Tier 3 Applications	GIS Team	OG	A	Training for users throughout the organization using the Tier 3 solutions (intranet, collector, dashboards). Two times a year or specialized for various departments. Conducted by GIS Team.	2x a year	2x a year	2x a year	2x a year	2x a year
Web Courses									
Getting Started with GIS	All Departments	OG	B	Course highlighting the basics of GIS	*	*	*	*	*
Referencing Data to Real-World Locations using ArcGIS	GIS Team	OG	B	Theory and practical use of geo-referencing	as needed	as needed	as needed	as needed	as needed
Finding Geographic Data in ArcGIS	GIS Team	OG	B	Theory and practical use of geo-referencing	as needed	as needed	as needed	as needed	as needed
Solving Spatial Problems Using ArcGIS	GIS Team	OG	B	Theory and practical use of geo-referencing	as needed	as needed	as needed	as needed	as needed
Creating and Sharing GIS Content using ArcGIS Online	GIS Team	OG	B	Theory and practical use of geo-referencing	as needed	as needed	as needed	as needed	as needed

TRAINING AND EDUCATION (Continued)									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Regional Conferences/Workshops	GIS Team and other GIS Users	OG	A	Conferences	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
Communication Strategy									
GIS Users Group	GIS Team and GIS Users	OG	A	Quarterly meetings for GIS Users	*	*	*	*	*
GIS Day	All	MT	B	November of every year	*	*	*	*	*
Annual User Satisfaction Survey	GIS Team	MT	A	Anonymous survey for candid feedback January of each year	*	*	*	*	*
One-on-One Meetings	GIS Manager	OG	B	Monthly meeting with key decision makers and department heads	*	*	*	*	*
Executive Presentations	GIS Manager	MT	A	Highlighting the benefits of GIS throughout the organization	*	*	*	*	*
Implementation of Blogs, Email, and Social media	GIS Team	OG	B	For Communications	*	*	*	*	*
Newspapers and Television	GIS Team	OG	C	Share exciting GIS projects with the media	*	*	*	*	*
Brochures, newsletters and other marketing efforts	GIS Team	OG	B	Market success and services	*	*	*	*	*
Seminars	Various	MT	B	Throughout the year	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000
Grand Total by Year for Training and Education					\$48,000	\$43,000	\$43,000	\$43,000	\$43,000
DATA AND DATABASES									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Develop, formalize, and enforce standardized GIS data creation procedures across the enterprise	GIS Team	OG	A	Establish and enforce procedures that will add consistency to data creation.	*	*	*	*	*
Acquire/develop all desired layers based on needs assessments	GIS Team and Members of Key Departments and Consultant	OG	A	Obtain recommended layers from other government sources, create internally, or create with the use of consultants. Departments will need to consider funding the creation and/or augmentation of needed data. The GIS Team will consult with departments annually to discuss needed GIS layers and methods for creation/augmentation. Budget is for the inclusion of external resources to expedite collection. Including 3D model of City.	\$100,000	\$75,000	*	*	*
Officialize Data Governance Strategy and Implement a Data Management Program	GIS Team	OT	B	As per pages 8 – 13 of the Enterprise Data Management Strategy and Program Chapter.	*				

DATA AND DATABASES (Continued)									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Implement Address Point Layer Improvements and Master Address Database	GIS Team, PD, and Community Development. Others as Needed	OT	A	Implement Address Point Layer Improvements and Master Address Database	*				
Implement Street Centerline Changes	GIS Team, PD, and Community Development. Others as Needed	OT	A	As per pages 23 and 24 of the Enterprise Data Management Strategy and Program Chapter.	*				
GIS Consulting Services	GIS Team	OG	A	Annual fund to utilize outside expertise on an as needed basis. There are a well over 100 data and technology recommendations in this plan. Existing staff do not have the time to implement them all. Therefore, it is recommended to use a consulting firm/s to assist with the implementation and maintenance of many of these recommended solutions.	\$120,000	\$100,000	\$75,000	\$50,000	\$50,000
Data Mining	GIS Team with Consultant	OG	A	Using a data mining software package, systematically begin data mining from each of the existing IT systems used by the departments including OnBase, GoEnforce, HostCompliance, Progressive, Eden, Central Square, CivicRec, Lucity, Chamelon, and others. This will require extensive knowledge of SQL/Oracle nomenclature and the data mining tool. As per pages 26-29 of the Enterprise Data Management Strategy and Program Chapter.	*	*	*	*	*
Master Data List	GIS Team and Key Staff from Heavy Using Departments	OG	A	Actions as outlined on pages 31-35 of the Enterprise Data Management Strategy and Program Chapter. See Implementation Section for details.	*	*	*	*	*
Implement ArcGIS for Local Government	GIS Team with Consultant	OG	A	Review and deploy targeted ArcGIS for Local Government applications.	*	*	*	*	*
Database Design, Development, and Cleanup	GIS Team with Consultant	OT	A	It is recommended that the City review its geodatabase design and consider migrating to a standardized model such as the Local Government Information Model (LGIM) where possible. A consultant can be used to assist with this process. Summary of actions items on page 63 of the Enterprise Data Management Strategy and Program Chapter.	*				
Digital Data Assessment	GIS Team	MT	A	Use ArcGIS Data Reviewer annually on key data sets to find potential issues. It is recommended to use a consultant in the first year to do a digital data assessment of all layers.	*	*	*	*	*

DATA AND DATABASES (Continued)									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Metadata									
Metadata Policy and Standards	GIS Team with Consultant	OT	A	Establish metadata template, data to be populated, and policies for an update.	*				
Implement and Populate Metadata	GIS Team	OG	A	Implement metadata as described in the previous step	*	*	*	*	*
Grand Total by Year for Data and Databases					\$220,000	\$175,000	\$75,000	\$50,000	\$50,000
SOFTWARE - Year One Use a Consultant and With Full Staffing Remainder Can be Done In-House									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Public Facing Applications									
Implement ArcGIS Hub Premium	GIS Team and Consultant	OT	B	The GIS team in tandem with a consultant should implement a fully deployed ArcGIS Hub Premium site. ArcGIS Hub Premium comes with Initiatives that will engage the public and require interaction and commitment from the City. Fees are included in maintenance		*	*		
Home Ownership Associations (HOAs) Story Map for Community Development	GIS Team and Community Development	OT	C	Make residents aware of HOAs, contact information and ability to sign up for leadership.			*		
General Plan Story Map	GIS Team and Community Development	OT	A	Living Document Story Map that shares the highlights of the City's General Plan. This could be a showcase project.	*				
Great Park Virtual Tour	Great Park, GIS Team, and Consultant	OT	A	Either a series of embedded story maps and apps or a custom application that showcases Great Park to include: Navigation, Way finding, All facilities, Reservable facilities, Schedules, 3D view of buildings and stadium, and other key features. Showcase project. Annual fee for support and augmentation. Including inventory.	\$175,000	\$7,500	\$7,500	\$7,500	\$7,500
Irvine Green	Public Works and GIS Team	OT	B	Story map that highlights the City's green initiatives (food waste prevention, recycling facilities and programs, solar feasibility, and green cover).		*			
Transportation Plans	Transportation and GIS Team	MT	B	Living document story map to show key elements of the various transportation plans (ETA, SCAG, OCA, Bike Plans, etc.).		*	*	*	*
Internal Public Safety Story Map for Crime Briefings	Police and GIS Team	OT	A	Highlighting key trends and activities.	*				
Meet the Officer Story Map	Police and GIS Team	OT	B	Story map telling the story of the Police Department to include introducing patrol officers.		*			
National Night Out Story Map	Police and GIS Team	OT	B	Highlighting key events and elements of the National Night Out.		*			

SOFTWARE (Continued)									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Cold Case Story Map	Police and GIS Team	OT	B	Highlighting cold cases.		*			
Other Applications and Software									
Automated Data Mining Middleware Software	All	OT	A	Software product to automate data mining from the existing IT systems (OnBase ECM ,Eden, Progressive Solutions, Infor Gold , Central Square, CivicRec , Lucity, etc.).	\$10,000				
Implement Esri Web AppBuilder	Key Departments. Use Consultant as Needed	MT	A	Systematic Implementation of WebAppbuilder for Police, Public Works, and Community Development	*	*	*		
Implement Operations Dashboard for Police	Police	OT	A	View key metrics with live mapping.		*			
Implement Operations Dashboard for Public Works	Public Works	OT	A	Key metrics about infrastructure and projects.		*			
Implement Portal for ArcGIS	GIS Team with Consultant	OT	A	Eliminates the need to login for any of the Esri ArcGIS Online applications. Portal allows users to share maps, applications, and other geographic data with the organization.	*				
Migrate to ArcGIS Pro	All	OT	A	Systematic Implementation of ArcGIS Pro	In-House	In-House	In-House		
Further Implement Collector and Survey123	All Field Collecting Departments	OG	A	Various departments desired the ability to collect and view data in the field. Collector and Survey 123 should be further implemented as appropriate.	*	*	*	*	*
3D Visualization Software	GIS Team	OT	B	Irvine should acquire Esri's City Engine and ArcGIS Urban as per pages 49-50 of the Needs Assessment chapter. Projects should be undertaken to showcase the capabilities of these software products. Annual fee included in maintenance		*			
Drone2Map	GIS Team	OT	B	Esri software to convert drone imagery to GIS data. Annual fee included in maintenance.			*		
Expand the CIP Software Effort	GIS Team , Pertinent Deaprtments, and Consultant	OT	A	Include all pertinent departments in the maintenance of capital project information. This should include the Esri Capital Project Tracking application and Story Maps.	*				
Additional Copy of Spatial Analyst	Police	OT	A	For Police	\$2,500				
Map Book software	Police Department	OT	B	Scripts and Esri tools for creating map books for Public Safety	*				
Emergency Operations Suite	EOC, GIS Team, and Consultant	OT	A	Common Operational Picture, EOC Dashboard, Damage Assessment Tools, Public Disaster Map, Story Maps. Ongoing support and maintenance	\$50,000	\$5,000	\$5,000	\$5,000	\$5,000
Parks Suite (Community Services)	Community Services, GIS Team, and Consultant	OT	A	Parks Intranet Portal, Ingetration with CivicRec and Lucity, Park Locator, Esri Community Analyst, Parks Story maps, Great Park Specific Application. Year one fee includes data collection and full suite implementation. Subsequent years are support and maintenance of suite	\$150,000	\$5,000	\$5,000	\$5,000	\$5,000

SOFTWARE (Continued)									
Task	Department	Task Type	Ranking	Notes	Year 1	Year 2	Year 3	Year 4	Year 5
Esri Community Analyst	CD and Parks	OG	B	Two copies (CD and Parks). Annual fee of \$200 is listed in the maintenance section.	*	*	*	*	*
Crowdsource Reporter and Manager	Enterprise	OT	B	Feedback from the public.		*			
My Government Services	Enterprise	OT	A	Configuration of Web AppBuilder.	*				
Economic Development Suite	Economic Development, GIS Team and Consultant	OT	A	As per pages 76 – 79 of the Needs Assessment to include	*	\$75,000	\$5,000	\$5,000	\$5,000
Acquire Esri Data Reviewer	GIS Team	OT	A	For annual data assessment	\$2,500				
Grand Total by Year for Software					\$390,000	\$92,500	\$22,500	\$22,500	\$22,500
Yearly Totals					\$698,100	\$377,700	\$209,200	\$184,200	\$184,200

Normal Task
Repeated Each Year
As Needed

Strategic Plan of Action Schedule

Five Year Tactical Plan of Action Schedule

Tactical Item	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
GOVERNANCE																				
GIS Steering Committee																				
Expand the Technical Project Manager Practice to GIS																				
Annual User Survey																				
GIS Users Group																				
Annual Return on Investment and Alignment Analysis																				
Annual Update to the Strategic Plan																				
Create and Adopt a GIS Vision, Goals and Objectives																				
Annual Reivew of Goals and Objectives																				
Develop an Annual Detailed GIS Work Plan																				
Develop a Training and Education Plan																				
Geospatial Customer Engagement Team																				
Improve Addressing Process																				
INFRASTRUCTURE																				
Review and implement GIS architecture design improvements (as per the Infrastructure Chapter)																				
Ensure big data readiness																				
Optimize web content generation																				
Create domain certificates and apply to all machines to fully support HTTPS traffic across all levels of the GIS																				
Regular updates to the most recent patch release of the ArcGIS Enterprise platform.																				
Review and Maximize ArcGIS Enterprise Performance																				
Optimize servers as needed																				
Implement role based security																				
SAN storage for SQL Server																				
Review and optimize imagery storage																				
MAINTENANCE																				
Esri Software																				
Two Copies of Community Analyst																				
ArcGIS Hub Premium																				
Data Mining Middle Ware																				
ArcGIS Urban																				
Additional Seat of Spatial Analyst																				
Data Reviewer																				
Drone2Map																				

TRAINING AND EDUCATION																				
Tactical Item	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Annual Training Budget for GIS Team			■				■				■				■				■	
Annual Training Budget for Onsite Training			■				■				■				■				■	
ArcGIS I- Introduction to GIS																				
ArcGIS Desktop II – Essential Workflows																				
ArcGIS Desktop III - Performing Analysis																				
ArcGIS IV – Sharing Content on the Web																				
Creating and Editing Data with ArcGIS Pro																				
Deploying and Maintaining Multiuser Geodatabases																				
System Architecture Design Strategies																				
ArcGIS Enterprise: Configuring a Base Deployment																				
Developing Web Apps with ArcGIS API for JavaScript																				
Putting ArcGIS to Use Across Your Organization																				
ArcGIS Pro: Essential Workflows																				
Migrating from ArcMap to ArcGIS Pro																				
Sharing GIS Content Using ArcGIS																				
Configuring Web Apps Using the Web AppBuilder for ArcGIS																				
Field Data Collection and Management Using ArcGIS		■				■				■				■				■		
Tier 3 Applications		■		■		■		■		■		■		■		■		■		■
TRAINING AND EDUCATION (Web Courses)																				
Getting Started with GIS																				
Referencing Data to Real-World Locations using ArcGIS																				
Finding Geographic Data in ArcGIS																				
Solving Spatial Problems Using ArcGIS																				
Creating and Sharing GIS Content using ArcGIS Online																				
Regional Conferences/Workshops																				
TRAINING AND EDUCATION (Communication Strategy)																				
GIS Users Group	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
GIS Day				■				■				■				■				■
Annual User Satisfaction Survey			■				■				■				■				■	
One-on-One Meetings																				
Executive Presentations				■				■				■				■				■
Implementation of Blogs, Email, and Social media																				
Newspapers and Television																				
Brochures, newsletters and other marketing efforts																				
Seminars																				

DATA AND DATABASES																				
Tactical Item	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Develop, formalize, and enforce standardized GIS data creation procedures across the enterprise	[Bar]																			
Acquire/develop all desired layers based on needs assessments	[Bar]																			
Officialize Data Governance Strategy and Implement a Data Management Program	[Bar]																			
Implement Address Point Layer Improvements and Master Address Database	[Bar]																			
Implement Street Centerline Changes	[Bar]																			
GIS Consulting Services	[Bar]																			
Data Mining	[Bar]																			
Master Data List	[Bar]																			
Implement ArcGIS for Local Government	[Bar]																			
Database Design, Development, and Cleanup	[Bar]																			
Digital Data Assessment				■				■				■				■				■
DATA AND DATABASES (Metadata)																				
Metadata Policy and Standards	[Bar]																			
Implement and Populate Metadata	[Bar]																			
SOFTWARE																				
Tactical Item	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
SOFTWARE (Public Facing Applications)																				
Implement ArcGIS Hub Premium	[Bar]																			
Home Ownership Associations (HOAs) Story Map for Community Development	[Bar]																			
General Plan Story Map	[Bar]																			
Great Park Virtual Tour								■				■				■				■
Irvine Green	[Bar]																			
Transportation Plans	[Bar]																			
Internal Public Safety Story Map for Crime Briefings	[Bar]																			
Meet the Officer Story Map	[Bar]																			
National Night Out Story Map	[Bar]																			
Cold Case Story Map	[Bar]																			
SOFTWARE (Other Applications and Software)																				
Automated Data Mining Middleware Software		■																		
Implement Esri Web AppBuilder	[Bar]																			
Implement Operations Dashboard for Police	[Bar]																			
Implement Operations Dashboard for Public Works	[Bar]																			
Implement Portal for ArcGIS	[Bar]																			

Strategic Implementation Plan
City of Irvine | CA

SOFTWARE (Continued)																				
Tactical Item	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Migrate to ArcGIS Pro	[Blue bar]																			
Further Implement Collector and Survey123	[Blue bar]																			
3D Visualization Software	[Blue bar]																			
Drone2Map																				
Expand the CIP Software Effort	[Blue bar]																			
Additional Copy of Spatial Analyst																				
Map Book software	[Blue bar]																			
Emergency Operations Suite	[Blue bar]																			
Parks Suite (Community Services)	[Blue bar]																			
Esri Community Analyst																				
Crowdsource Reporter and Manager	[Blue bar]																			
My Government Services	[Blue bar]																			
Economic Development Suite	[Blue bar]																			
Acquire Esri Data Reviewer																				

- **Web Services and Data Sharing –**

Although already in existence, web services and data sharing are just in their infancy. The push in the GIS industry now is to make GIS data shareable and available. Esri's software currently allows users to consume data from external feeds. ArcGIS Online is a cloud-based geospatial content management system for storing and managing maps, data, and other geospatial information. Built on Esri's cloud infrastructure, it gives users access to geographic content shared and registered by Esri and GIS users around the world. Other vendors, such as Microsoft, are providing similar tools. Over the next decade, GIS users will transparently be consuming data provided from any number of sources.



- **Enterprise Integration –** GIS, as the integration tool for local government, has been heralded for many years. The idea is that GIS becomes the portal into all databases within an organization (spatial and non-spatial). For instance, integration between GIS, work management, asset management, outage management, and customer information systems is a



desire of local government. Another example is utilizing a GIS address layer as the de-facto address database serving all non-spatial applications. This has not been and will not be an overnight process. Strides have been made over the past few years. Local governments have begun to make integration a mandatory component of any new software system acquisition. Therefore, software vendors are upgrading their software to meet this demand. Over the next decade, this trend will continue. Local government will inch closer and closer to accessing all of their enterprise data through a GIS front-end.

- **Low-cost spatial data collection tools and digital data**

– The cost of data collection has plummeted over the past decade. Tools have advanced, giving the ability for local government to acquire or collect information. Data collection methods and data availability will continue to expand. Local government GIS staff will need to integrate the ever-increasing volume of data to include: radio frequency identification (RFID), automated meter reading (AMR), digital imaging cameras, airborne and terrestrial LIDAR, and remote sensing satellites. An ever-increasing volume of digital data will be consumed via the GIS.



- **Location-based services and location tracking**

– Public safety has led the way with regards to integrating customer location with the services provided. E-911 and Phase II regulations have allowed agencies to view the spatial location of any call for service (land line calls and cellular calls). Utilizing location-based services (LBS) has become ubiquitous for smart phone users. Users can quickly locate their favorite restaurant, an ATM, or any desired services based on their current location and a GIS mapping application. Local governments are implementing automated vehicle location (AVL) to track their fleet. Over the next decade, this will become more prevalent for public and private use. Users will expect local governments to automatically provide LBS information on road closures, the location of the nearest park with desired amenities, the location of special events, parks and recreation offerings, availability of a book at a local library, and the location of the garbage truck that will be picking up their trash. Additionally, users will expect this data to be pushed to their mobile devices. For instance, the trash truck is within an hour of a house for pickup and the customer gets a message letting them know so they can move their trash and/or recycling can(s) to the curb.



- **Citizen notification** – Akin to LBS, discussed in the last bullet, is citizen notification. Public safety has led the way of late in implementing applications that will notify citizens if a crime occurs within a certain distance of their houses, schools, places of worship, etc. Citizens are beginning to expect this type of information to be emailed, texted, or automatically phoned to them. GIS is utilized as the method of geo-enabling an existing database and comparing the event in the database with the citizen's location of concern. The demand for this type of information will continue to increase. It will be expected that a local government will notify citizens when a change of any type is occurring nearby. For example, Wayne County, Washington provides its citizens with geo-enabled crime, inspection, nuisance abatement, and school/restaurant sanitation grade information based on a user's geography.



- **Mobile GIS** – Mobile computing has exploded over the past few years. Tablets and smartphones like the iPod, iPhone, and Android devices now have GIS applications available. The proliferation of smartphones will help increase the pressure on software companies to continue to produce mobile applications and as computing power and capability increases for such devices, so too will the number of software companies offering mobile solutions. Expect all GIS software companies to offer their core software on these mobile devices. Additionally, a majority of GIS end-user applications will become untethered from the traditional personal computer.



Conclusion

It is clear that staff throughout the City need to and desire to continue to utilize GIS technology to conduct their daily tasks. GIS use in local government is going to become more pervasive. GIS will become the de facto portal for managing and analyzing all data at the City (spatial and non-spatial). The spread of GIS tools has been significant over the past few years. Also, citizens are equipped with an ever increasing array of GIS-based tools. They have location aware phones and an assortment of mobile devices. Over the next decade, this will become more prevalent. Users will expect local governments to automatically provide location-based service (LBS) information on road closures, the location of the nearest city facility with desired amenities, the location of special events, utility services, and the location of projects throughout the City. This can only be accomplished through the use of GIS. The City has invested in GIS and will continue to do so. The importance of GIS at the City will continue to increase. Therefore, it is critical to the success of the organization as a whole that the recommendations made in this report are adopted and implemented. This will ensure that the City's GIS investment will be viable and will be able to meet the ever-increasing demand.