LX KOREA LAND AND
GEOSPATIAL INFORMATIX CORPORATION

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Drought and Flood Prevention with Using Green Roofs and Building Spatial Information

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Introduction

Increase in **impervious surface areas** in South Korea

Increase in **stormwater runoff**

Increase in funds for **the River Improvement Project**

Million

2006	$801
2007	$861
2008	$887
2009	$1,150
2010	$928
2011	$941
2012	$1,076

Purposes

W hat is the effective system to

extract impervious surface areas?

manage stormwater runoff?

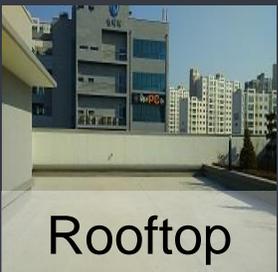# Study Areas

Seven metropolitan cities in South Korea

	City area (km^2)	Population(million)
Seoul	600	10.2
Busan	760	3.5
Daegu	850	2.5
Incheon	1000	2.8
Gwangju	500	1.4
Daejeon	540	1.5
Ulsan	1060	1.2

Reference: https://www.google.co.kr/maps

건물정보
Building Data
建物情報

Impervious Surface Areas

Road

Sidewalk

Driveway

Parking lot

Rooftop

Anthropogenic features through which water cannot infiltrate soil

Associated with increasing urbanization

A key indicator in assessing urban environments

Flood discharge: At least 250 percent higher in urban compared to forested catchments

However, accurate impervious surface extraction is still a challenge

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Extracting Building Data

Building data From 1.1.2015 to 12.31.2015

	Numbers of new buildings	Roof area (m²)
Seoul	1,730	514,330
Busan	729	382,640
Daegu	133	44,204
Incheon	549	170,234
Gwangju	103	32,751
Daejeon	108	29,410
Ulsan	295	365,131
Total	**3,674**	**1,538,700 m²**
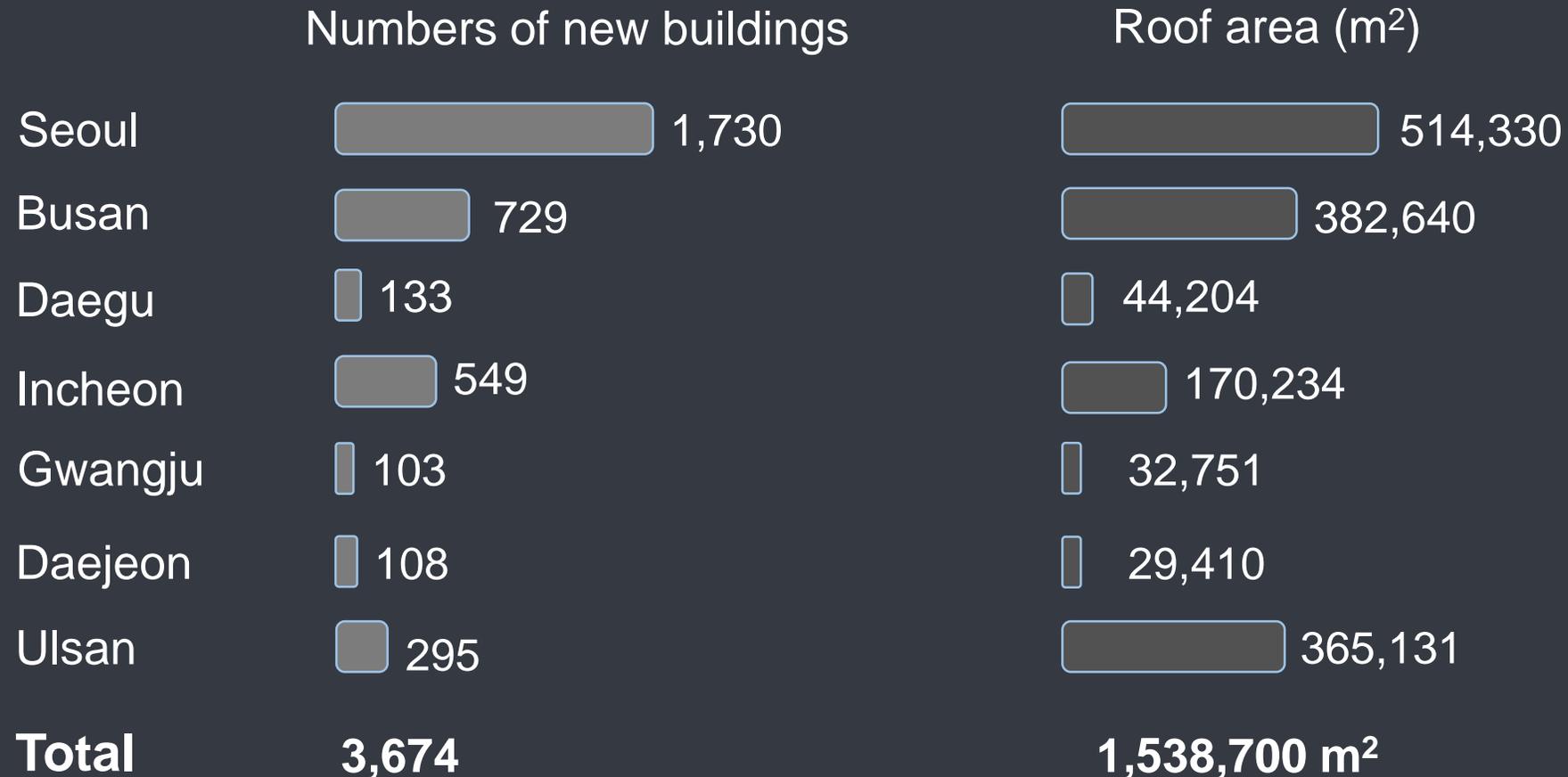
Extracting Building Data

Urbanization rates in 2015

Seoul > Busan > Ulsan > Incheon > Daegu > Gwangju > Daejeon
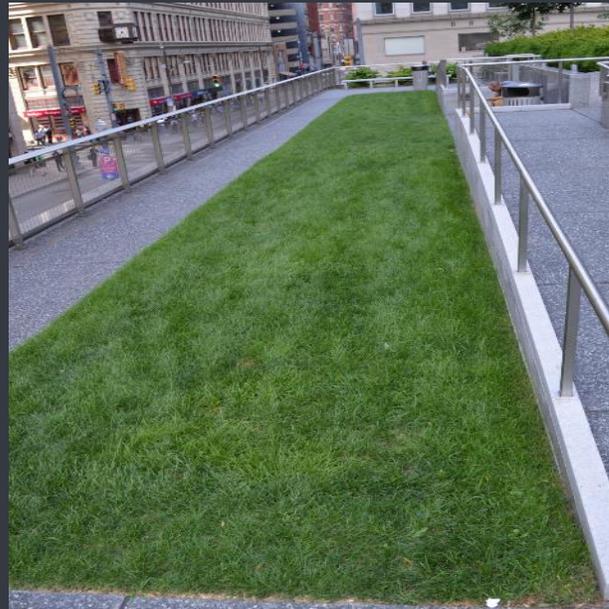
Impervious surface areas from constructing buildings

Seoul = **Twenty times** higher urbanization rates than Daejeon

Drought and Flood Prevention

Literature Review
Green Roofs

Intensive systems

Extensive systems

Benefits

Energy savings
Stormwater Management
Air quality
Urban heat island
Water quality
Life cycle
Biodiversity
Fire Protection
Noise pollution

Methods

Reduced stormwater runoff with installing green roofs
 - Roof area × Annual precipitation × 56%

Cost benefits from reducing stormwater runoff with installing green roofs
 - Reduced stormwater runoff($/kgal) × $2.27

Cost benefits from saving stormwater runoff with installing water tanks
 - The amount of water a family uses for toilets(m^3) × numbers of buildings × $0.67

가뭄예방
Drought Prevention
魃豫防

Literature Review
Drought Prevention

Water cisterns with green roofs

New York - Sustainable Stormwater Management Plan

Cisterns harvest **stormwater** in large above
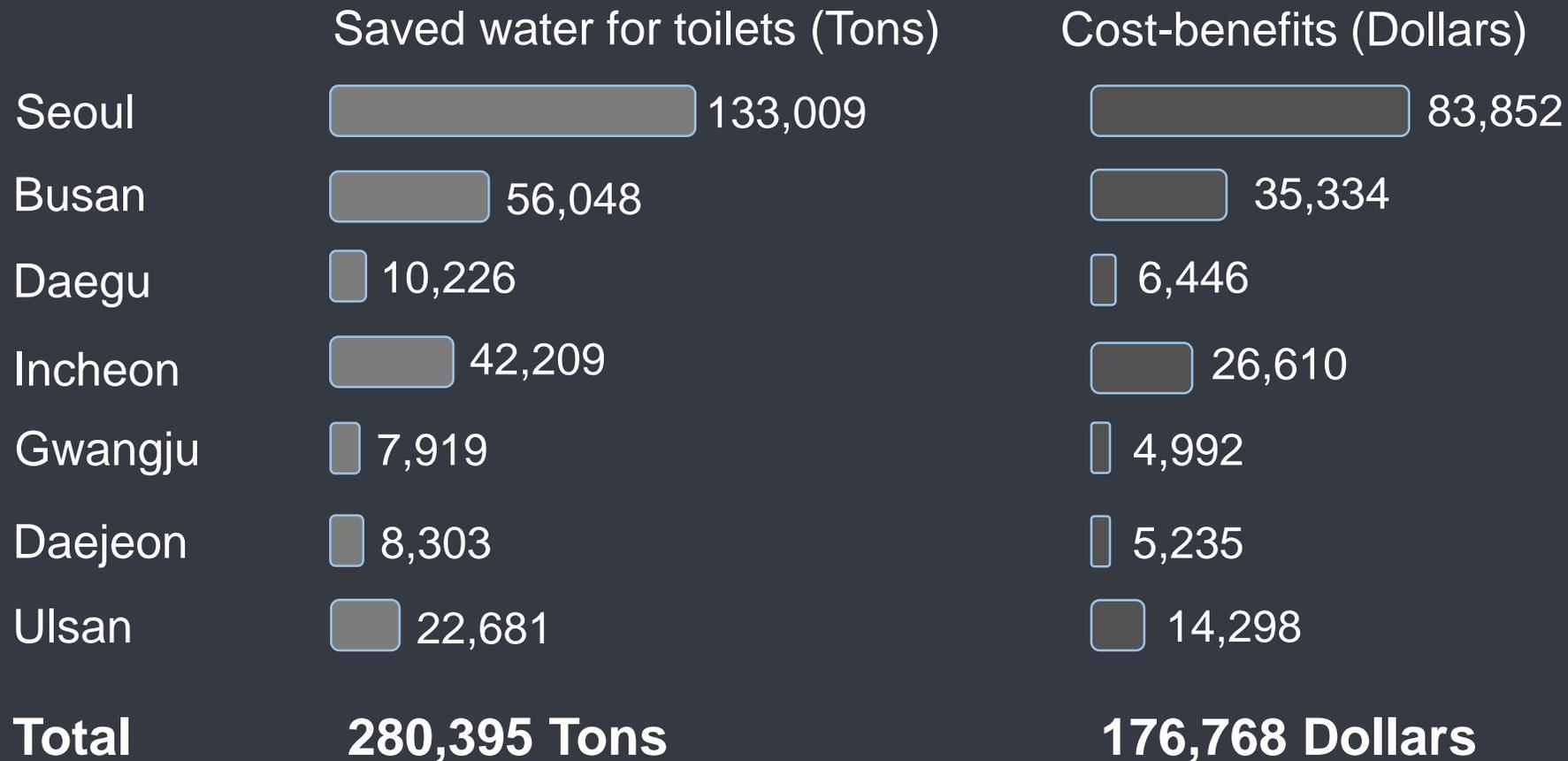or below-ground tanks to store water from downspout.

Cisterns can be placed underground or inside buildings.

The appropriate location of a cistern depends
upon the configuration of **roof drains**
and the routing of plumbing infrastructure.

홍수예방
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Literature Review
Flood Prevention

The City of Portland - Sustainable Stormwater Management

Stormwater management

Energy

Climate

Habitat

Amenity Value

Building Development

4,000m² of roof areas	Roof Type	Runoff Quantity	
Stormwater Runoff (gal/year)	Conventional Roofs	877,000	
	Green Roofs	406,000	
	Annual Volume Reduction	**471,000**	↓56%
Peak Flow (cfs)	Conventional Roofs	0.88	
	Green Roofs	0.03	
	Peak Flow Reduction	**0.85**	↓96%

Flood Prevention

Reducing annual stormwater runoff
on 1,538,700 m^2 of roof areas on 3,674 buildings

	Reduced stormwater (Tons)	Cost-benefits (Dollars)
Seoul	41,139	69,857
Busan	116,909	198,521
Daegu	8,657	14,700
Incheon	24,234	41,152
Gwangju	7,736	13,137
Daejeon	5,643	9,583
Ulsan	88,189	149,752
Total	**292,508 Tons**	**496,700 Dollars**

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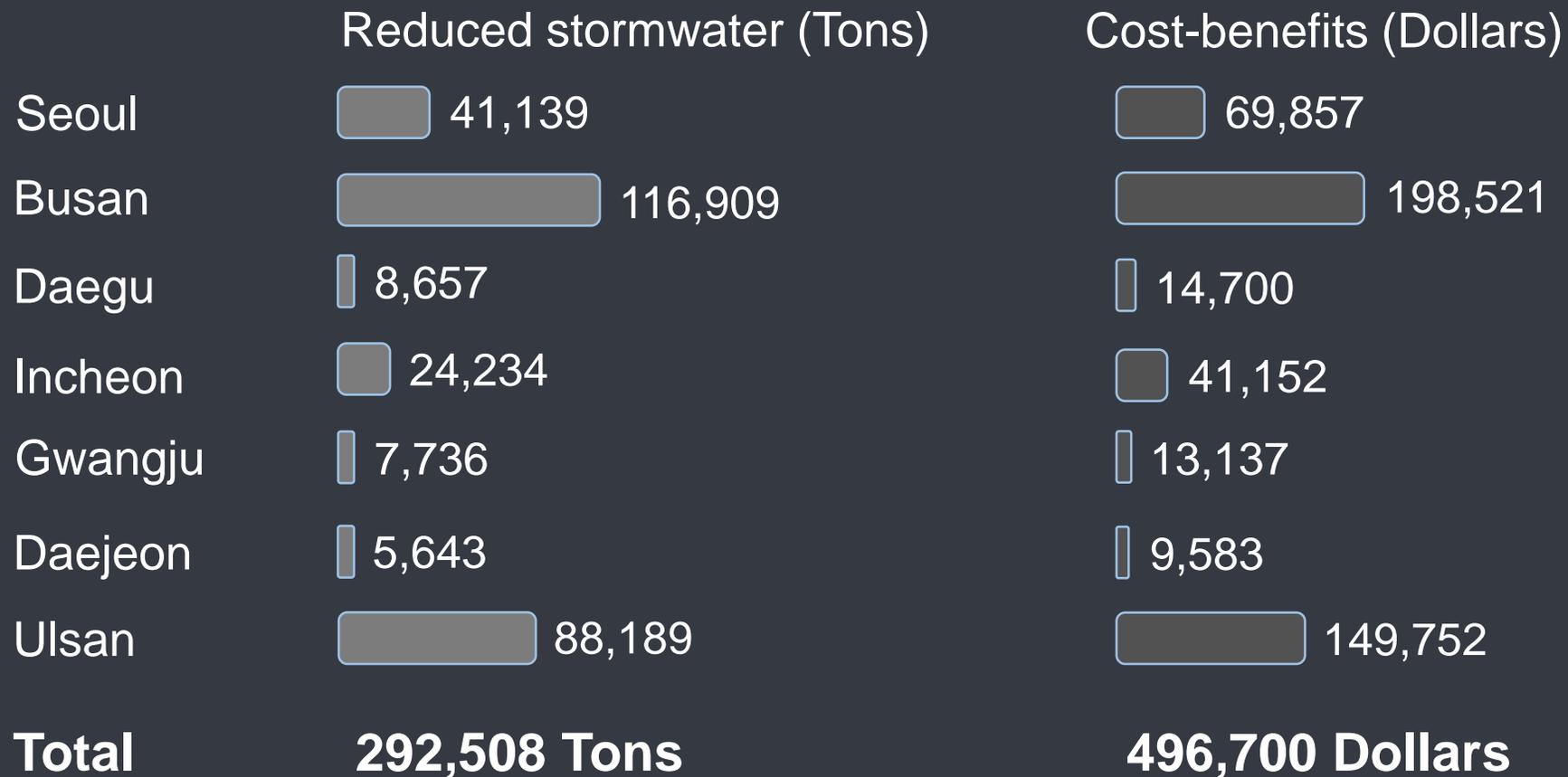
Flood Prevention

Most important three metropolitan cities
to install green roofs for reducing stormwater runoff

Busan

Ulsan

Seoul
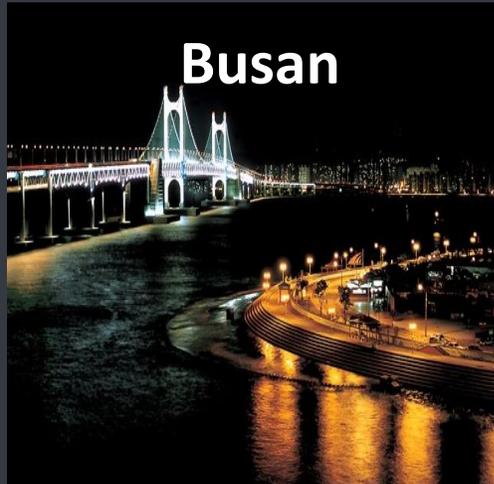
Higher Urbanization and Precipitation
than other cities

Flood Prevention

Reducing stormwater runoff
on 1,538,700 m^2 of roof areas on 3,674 buildings

The biggest floods in seven cities from 2010 to 2015

Cities	Day	Precipitation (mm)	Numbers of buildings	Stormwater runoff (ton/day)
Seoul	2011-07-27	301	1730	54,672
Busan	2014-08-18	130	729	17,499
Daegu	2010-08-15	105	133	1,639
Incheon	2010-09-21	176	549	10,581
Gwangju	2014-08-17	120	103	1,388
Daejeon	2014-07-18	86	108	888
Ulsan	2014-08-18	212	295	27,284

Flood Prevention

Reducing stormwater runoff
on 1,538,700 m² of roof areas on 3,674 buildings

Seoul 2011-07-27
1,730 buildings
Stormwater runoff
(ton/hr) **2278 → 1002 (↓1,276)**
Saving $955

Busan 2014-08-18
729 buildings
Stormwater runoff
(ton/hr) **729 → 321 (↓408)**
Saving $305

Daegu 2010-08-15
133 buildings
Stormwater runoff
(ton/hr) **68 → 30 (↓38)**
Saving $28

Reference: www.yonhapnews.co.kr

Flood Prevention

Reducing stormwater runoff
on 1,538,700 m^2 of roof areas on 3,674 buildings

Incheon 2010-09-21
549 buildings
Stormwater runoff
(ton/hr) **441 → 194 (↓247)**
Saving $185

Gwangju 2014-08-17
103 buildings
Stormwater runoff
(ton/hr) **58 → 25 (↓33)**
Saving $25

Daejeon 2014-07-18
108 buildings
Stormwater runoff
(ton/hr) **37 → 16 (↓21)**
Saving $16

Flood Prevention

Reducing stormwater runoff
on 1,538,700 m^2 of roof areas on 3,674 buildings

Reducing stormwater runoff

Totally 2,660 tons per hour

Saving $4,517 per hour

Ulsan 2014-08-18

295 buildings
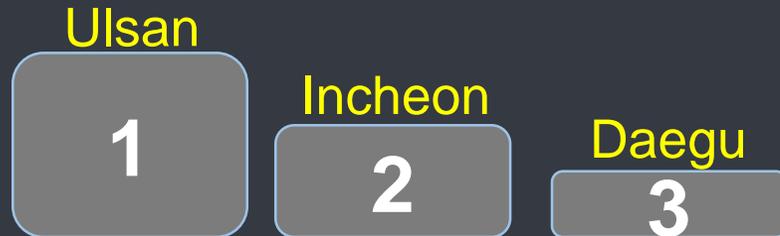Stormwater runoff
(ton/hr) **1137 → 500 (↓637)**
Saving $1,082

Reference: www.yonhapnews.co.kr

Conclusions   Ranks

Population

Seoul
1

Busan
2

Incheon
3

City area

Ulsan
1

Incheon
2

Daegu
3

Urbanization rates

Seoul
1

Busan
2

Ulsan
3

Cost-benefits from installing water cisterns

Seoul
1

Busan
2

Incheon
3

Reducing annual stormwater runoff

Busan
1

Ulsan
2

Seoul
3
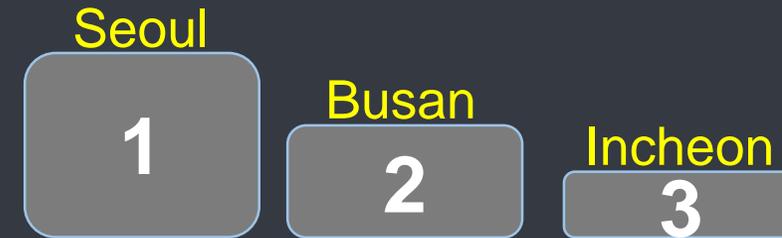
Benefits from reducing stormwater runoff During the biggest flood

Seoul
1

Ulsan
2

Busan
3

Conclusions

- SIMC of Korea Land and Geospatial InformatiX Corporation -

Effective system to extract building data

- Green Roofs -

Collecting and reducing stormwater runoff

- River Improvement Project -

Making plans for installing green roofs

- SIMC of Korea Land and Geospatial InformatiX Corporation -

Using for National and municipal to resolve variable environmental problems

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Thank You

Q & A

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