

深圳市低冲击开发应用与研究

Research and application on LID in Shenzhen

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背景 Background

高速城市化进程带来各种水问题，亟待寻找新的城市建设模式：
Rapid urbanization cause serious water environmental problems.

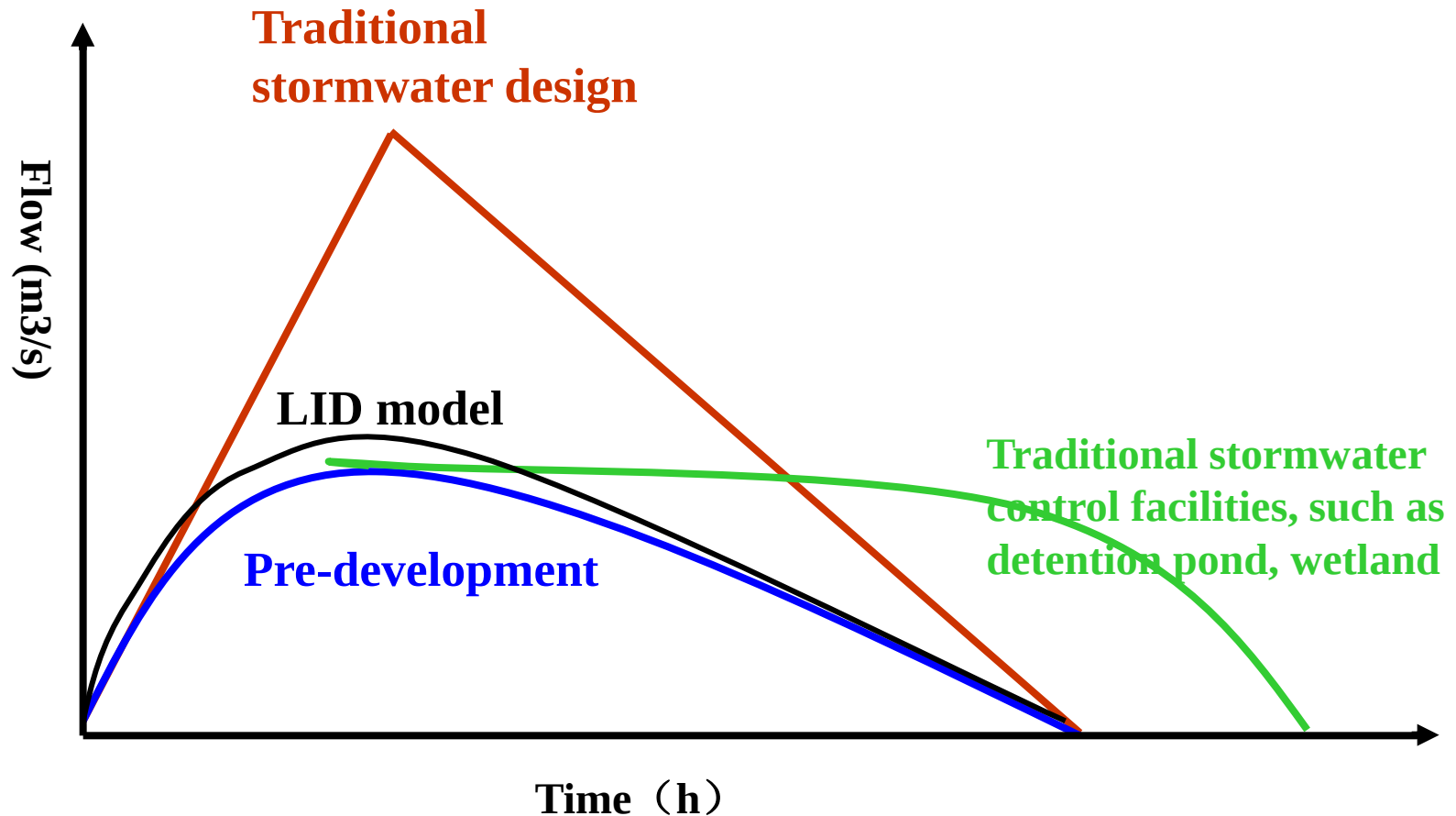
- 洪涝灾害频发 Floods
- 面源污染严重 Serious non-point source pollution
- 水资源短缺 Water resources shortage



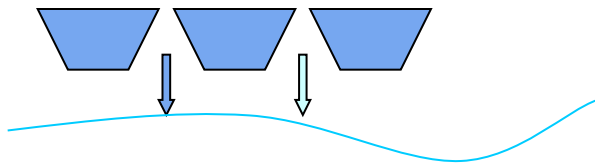
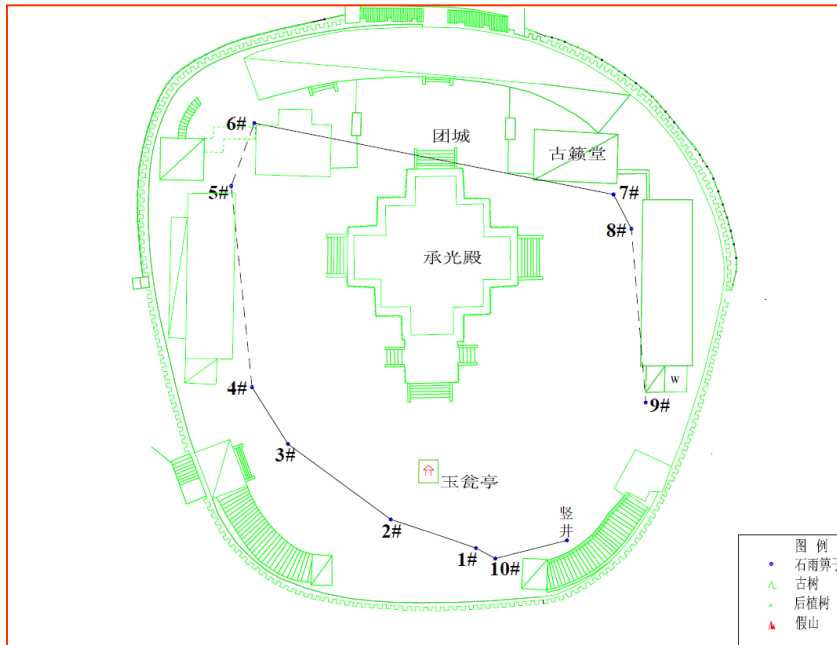
Flood in Guangzhou, China, Jul. 2011

低冲击开发（低影响开发，Low Impact Development, LID）能在一定程度上解决城市化带来的生态、水问题。

LID has well performance for flood reduction and non-point source pollution control.



低影响开发是一种新模式，但它的理念早已体现在古人的城市建设过程中。
The stormwater management idea in ancient China.



倒梯形青砖-地面入渗
九口渗透井-渗透设施入渗
Infiltration facilities

在向国际先进经验学习的同时，我们更重视通过自身的实践和经验总结来寻找适合的雨水综合利用模式。

We are finding the stormwater management ways which are fully localized and practical.

美国

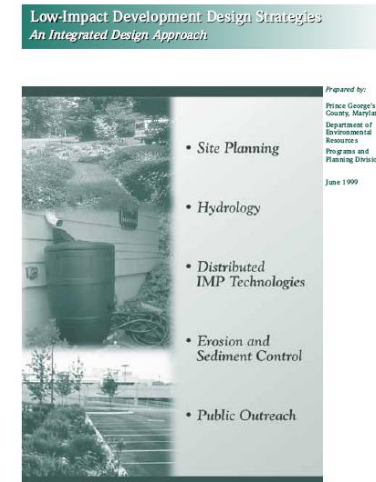
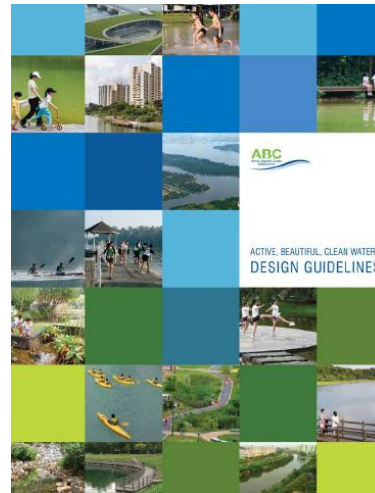
德国

日本

英国

澳大利亚

新加坡



LOW IMPACT DEVELOPMENT MANUAL FOR SARASOTA COUNTY

Prepared for:

SARASOTA COUNTY
1600 Sarasota Center Blvd.
Sarasota, Florida 34239

Prepared by:

JONES ENGINEERING & ARCHITECTS, INC.
730 HE WALKER ROAD
CHICKASAW, ALABAMA 36611

Chickasaw, Alabama 36611

and

UNIVERSITY OF FLORIDA
PROGRAM FOR RESOURCE EFFICIENT COMMUNITIES (PREC)
PO Box 110643
Gainesville, Florida 32611

and

WTE
481 Oakdale Drive
Winter Park, Florida 32789

December 2001



低冲击开发引入时间不超过十年，但发展迅速。

LID idea was introduced to Shenzhen lately, but developed rapidly and has been paid great attention.

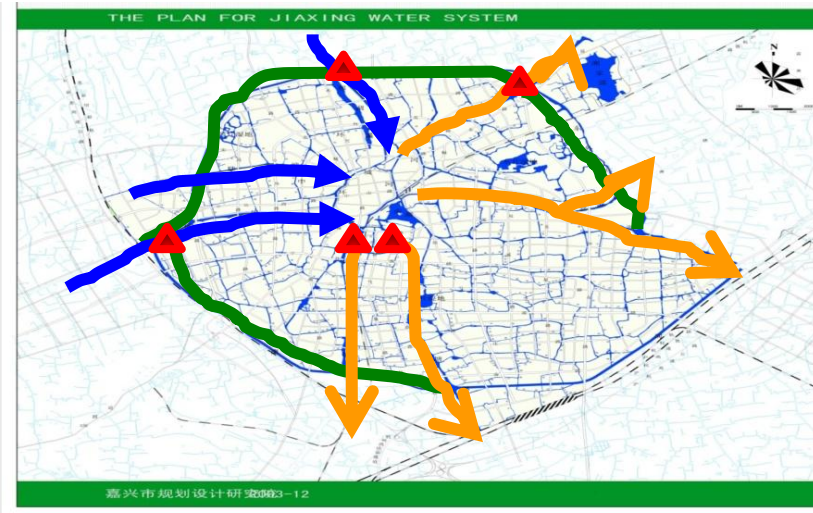
室外排水设计规范 Code for design of outdoor wastewater engineering (2011年版)

修订的主要技术内容是：补充规定除降雨量少的干旱地区外，新建地区应采用分流制；补充规定现有合流制排水地区有条件应进行改造；补充规定应按照低影响开发（LID）理念进行雨水综合管理；补充规定采用数学模型法计算雨水设计流量；补充规定综合径流系数较高的地区应采用渗透、调蓄措施；补充规定塑料管使用的条件；补充规定雨水调蓄池的设置和计算；更正生物滤池的设计负荷等。

北京，深圳，上海，昆明，苏州、嘉兴等城市已开展低影响开发的研究与应用。
More and more cities, such as Shenzhen, Beijing, Shanghai, Kunming, Suzhou and Jiaxing have started the research and practice of LID.

昆明：《昆明市城市雨水收集利用的规定》

嘉兴：建立低影响开发综合示范区3个，总汇流面积不少于5平方公里。





深圳应用综述

Abstract

深圳：三十一年历史的特大城市（2011年常住人口1046万）

Shenzhen: Megalopolis with 31 years history (population: 10.46millions in 2011)

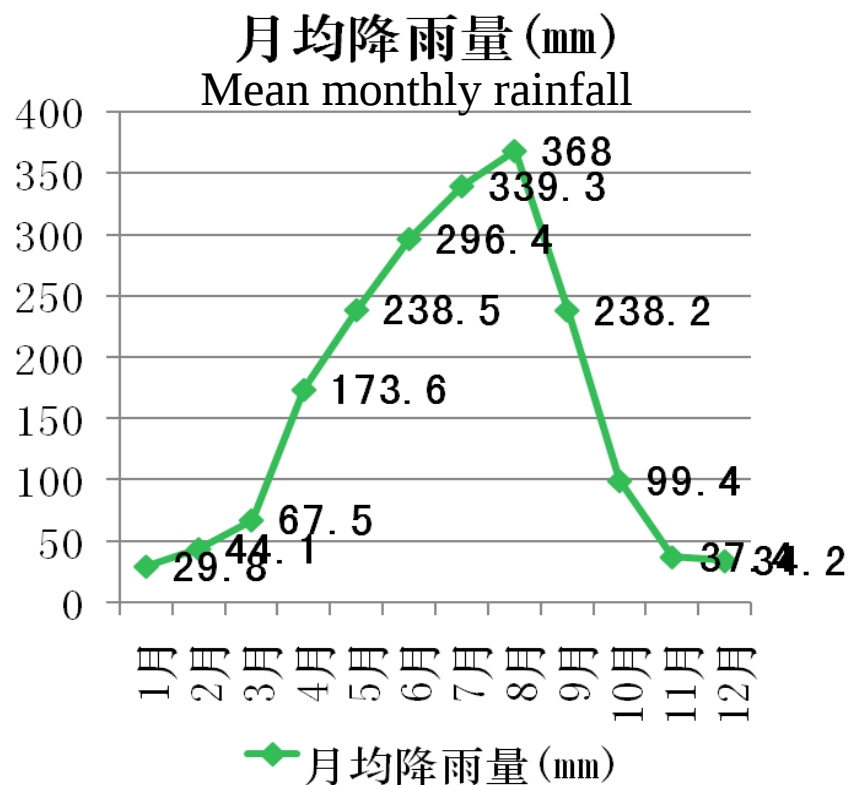
- 滨海城市，易受极端气候影响 Coastal city, easily affected by extreme climate.
- 水体短小，无客水过境，自净能力弱 Weak self-purification capacity due to the short streams and few foreign waters inflow.



降雨特点 Precipitation Characteristics:

总量丰富，单峰雨型 large amount and single peak rainfall pattern

雨季分明，暴雨频繁 distinguishable rainy season, and frequent rainstorms



占全年降雨量(%)
Proportion of rainfall in rain season

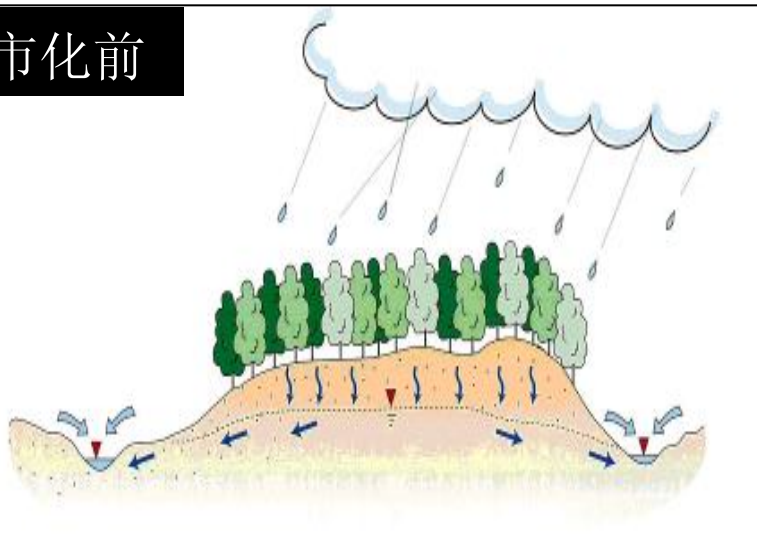


深圳应用LID的出发点

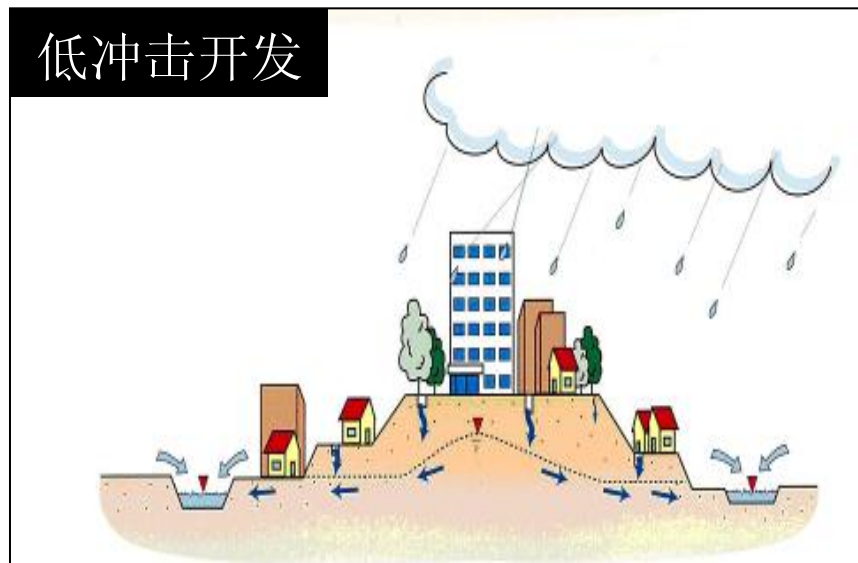
Why do we use LID idea in Shenzhen?

- 雨水径流污染控制 Non-point source pollution control
- 暴雨错峰、削峰 Flood/Peak flow reduction
- 适度增加水资源 water resource increase

城市化前



低冲击开发



- 2004年 举办第四届“流域管理与城市供水国际学术研讨会”，深圳市水务局与美国土木工程师协会和美国联邦环保局签署包括流域管理、面源污染控制和低冲击开发的技术交流与合作协议框架。

2004 “International symposium on watershed management and urban water supply ” was held in Shenzhen.

- 2005~2006年 开展《深圳市茜坑水库流域管理措施研究》，落实洪峰控制、面源污染控制、雨水综合利用的设计理念及设计方法。

2005~2006 <Study on watershed management measures of Xikeng reservoir in Shenzhen> was completed, in which the idea of flood reduction, non-point source pollution control, and stormwater management were implemented.

- 2007~2008年 开始编制《深圳市光明新区雨洪利用详细规划》，首次在城市区域开发中引入 低冲击开发理念，提出将建设项目雨水综合利用设施的规划、设计、审查纳入建设项目管理体系。

2007~2008 < Detailed planning of stormwater management in Guangming new district in Shenzhen> was started, in which the LID idea was involved in urban regional development firstly.

- 2009年，深圳市同意创建光明低冲击开发雨水综合利用示范区；
2009 LID demonstration area was approved by local government.

- 低冲击开发示范项目和示范区大量建设：万科中心；南山商业文化中心等；
2009 some LID demonstration programs were founded.

万科中心雨洪利用设施 LID facilities in Vanke center



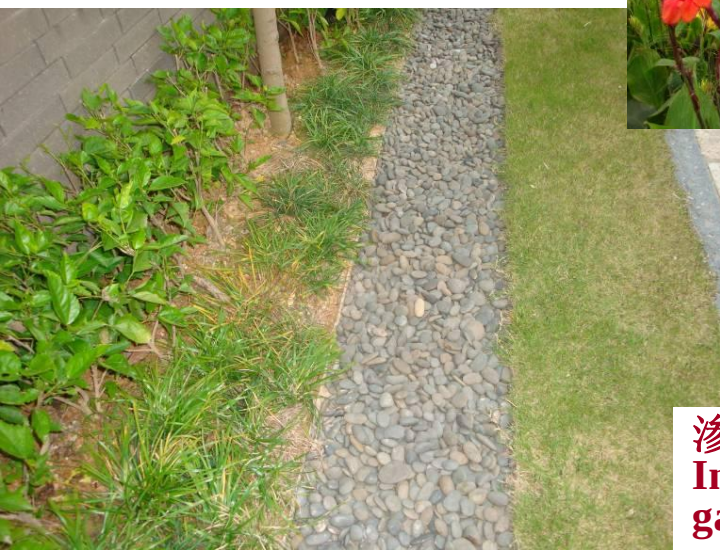
绿地+集水渠道
Natural drainage system



雨水花园
Rain gardens



雨水花园
Rain gardens



渗渠系统
Infiltration
gallery



透水地面
Porous
pavement

3

示范区及示范项目简介

LID demonstration area and LID projects

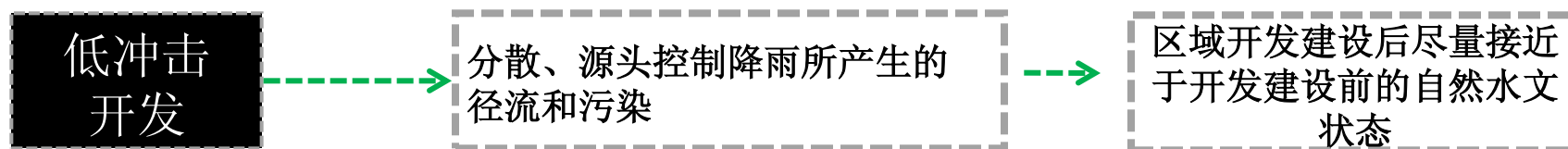
□ 示范区概况 Overview of Guangming new district, Shenzhen

- 位置：深圳西北地区。
Location: North-west of Shenzhen City
- 面积：3km²。
Area: 3km².

- 广深港客运专线在光明设站，光明新区将面临大规模的城市开发建设活动。
Facing large scale development and construction.



□ 示范区概况 Overview of Guangming new district, Shenzhen



采用雨水综合利用设施的
建设项目的
比例

人行道、停
车场、广场
透水铺装地
面比例

城市公共绿
地地下凹式建
设比例

绿化屋顶覆
盖比例

行车道 Roadway



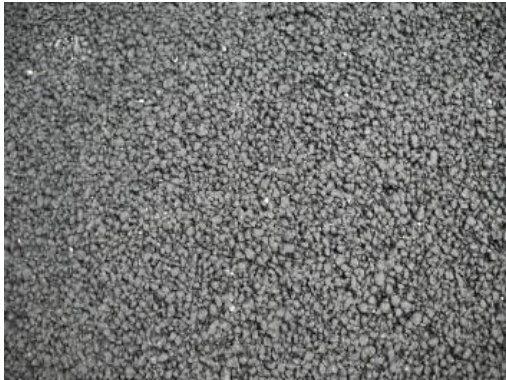
A-A断面

A-A section

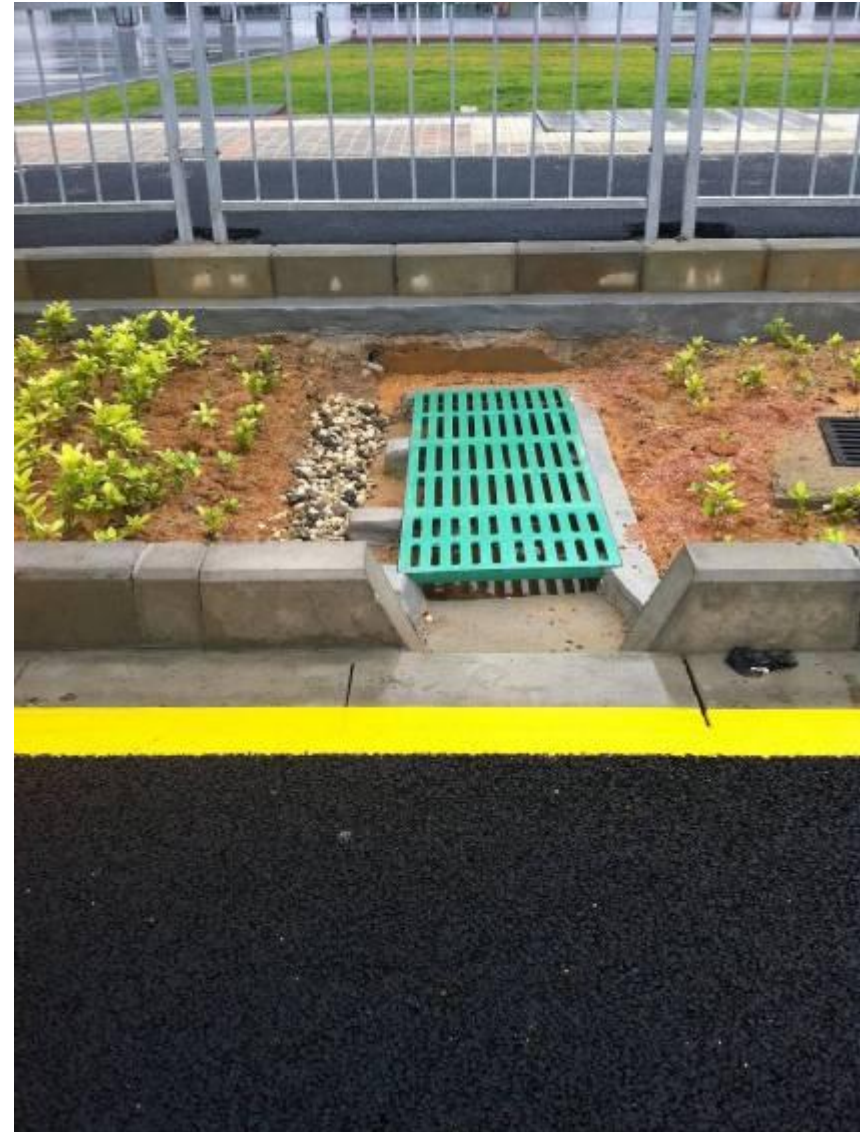
B-B断面

B-B section

□ 市政道路 Road



透水沥青
porous asphalt



□ 公园 Park



植被草沟
Vegetated
Swales



□ 公园 Park



雨水调蓄池
Stormwater storage tank

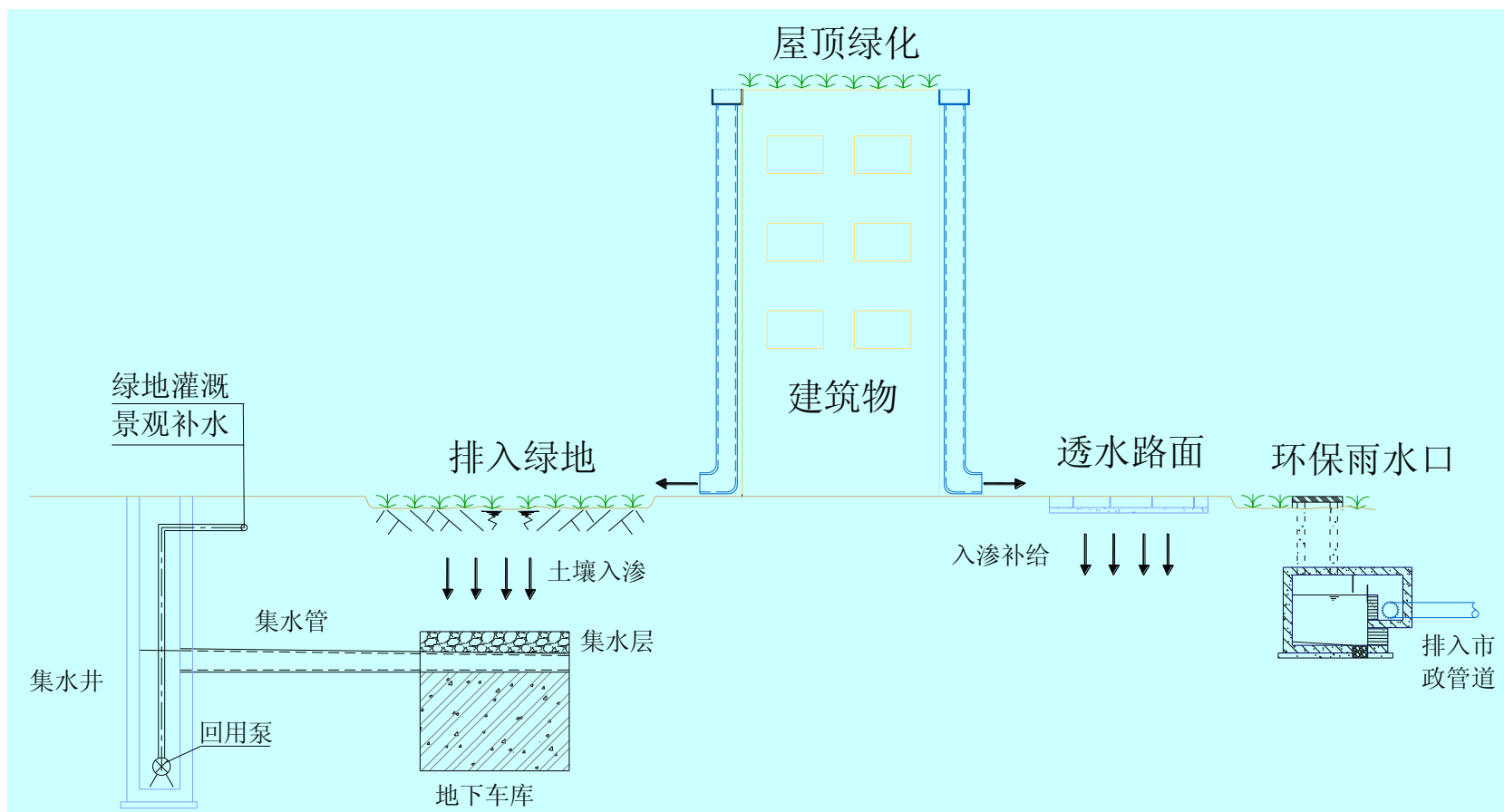


地下雨水蓄水池
Underground stormwater storage tank

公园内建有五个地下蓄水池，四个为 300m^3 ，一个为 250m^3 。

Five underground stormwater Storage tanks total in the park,
Volume: $4 \times 300\text{m}^3$, $1 \times 250\text{m}^3$ 。

□ 建筑小区 Building and sub-district





低影响开发基础研究

Progress of LID basic research

□ 水专项《低影响开发城市雨水系统研究与示范》 Water Pollution Control and Management Technology Major Projects < Research and demonstration on LID stormwater system in urban area >

低影响开发城市雨水系统研究与示范
Research and demonstration on LID stormwater system in urban area

课题一：绿色建筑与小区低影响开发雨水系统研究与示范

Project 1: Research and demonstration on LID stormwater system in green building and sub-district

课题二：城市道路与开放空间低影响开发雨水系统研究与示范

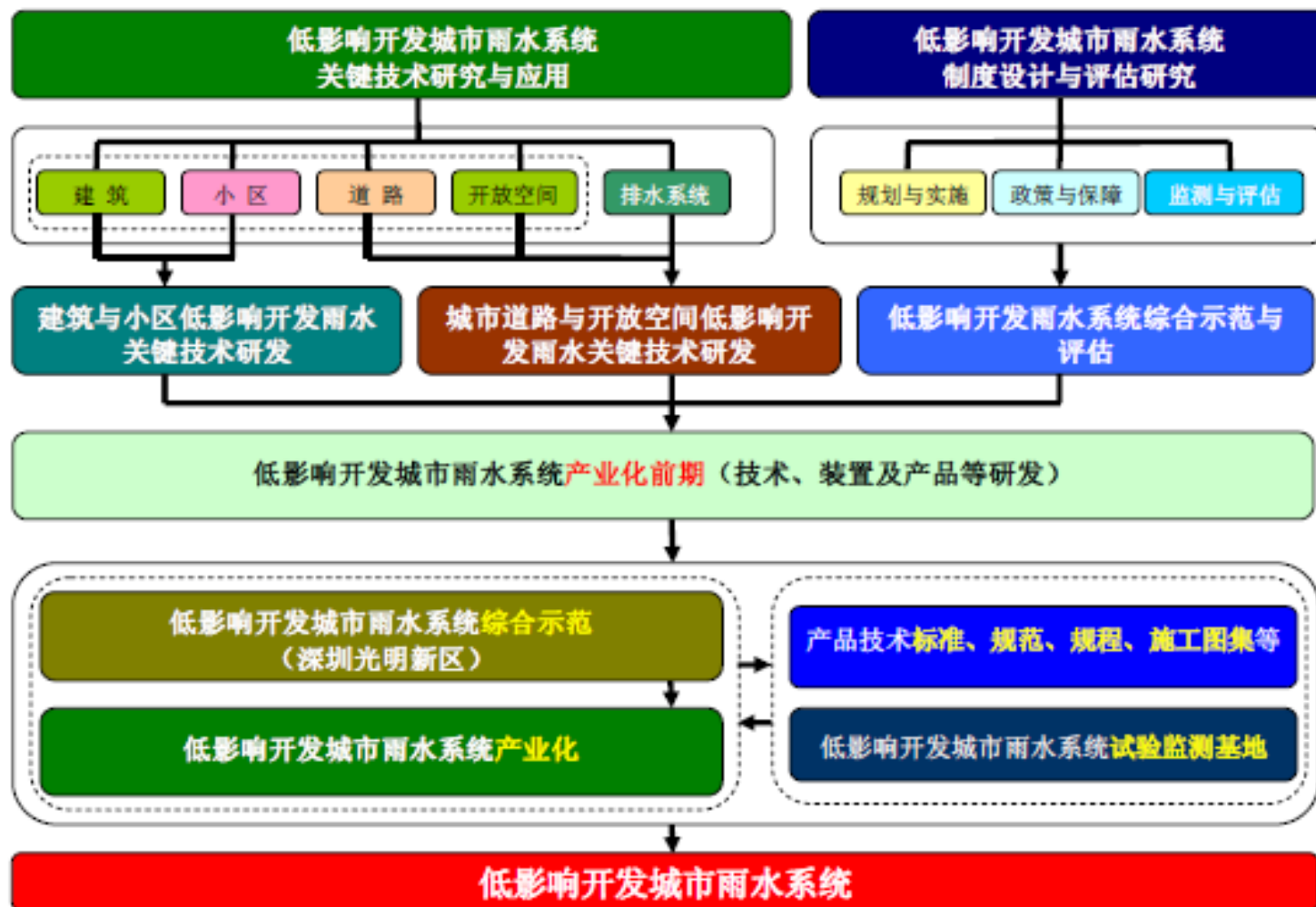
Project 2: Research and demonstration on LID stormwater system in urban road and open space

课题三：低影响开发雨水系统综合示范与评估

Project 3: Comprehensive demonstration and evaluation on LID stormwater system in urban area

□ 水专项《低影响开发城市雨水系统研究与示范》

< Research and demonstration on LID stormwater system in urban area >



□ 课题任务分解与主要研究内容

Task decomposition and main research contents

课题三：低影响开发雨水系统综合示范与评估课题

Project 3: Comprehensive demonstration and evaluation on LID stormwater system in urban area

- 低影响开发综合示范区规划与管理机制研究
Research on planning and management mechanism of LID demonstration area
- 低影响开发综合示范区和示范工程应用和集成
Research on application and integration of LID in southern China
- 低影响开发综合示范区和示范工程监测、评估与优化
Research on monitor, evaluation, and optimization of LID in south China

□ 关键技术 Key technologies

- (1) 现行规划建设管理体制如何引入和应用低影响开发理念；

How to involve LID into current planning and construction management system in Shenzhen.

- (2) 如何构建城市低影响开发雨水系统的应用和管理保障体系；

How to establish the application & management guarantee system of LID in.

- (3) 如何集成应用多控制目标的低影响开发雨水措施或技术；

Integrated application of LID measures and technologies that are multi-targets.

- (4) 研发低影响雨水系统的量化评价技术；

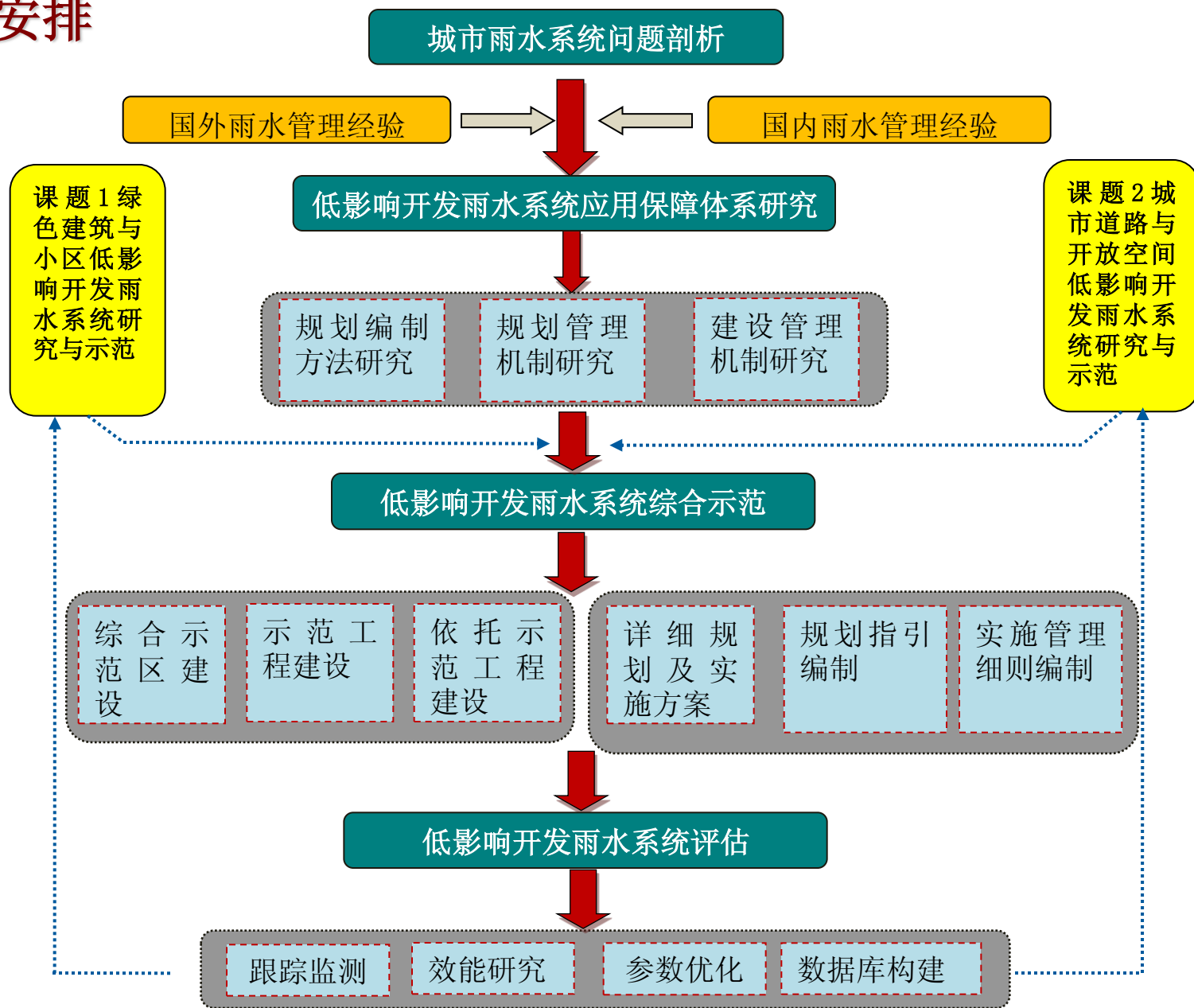
Develop quantitative evaluation technology of LID.

- (5) 优化低影响开发技术；

LID facilities optimization.

□ 时序安排

2011-2015年





技术导则规范 LID standards & specs.

国标 The national standard:

- 《建筑与小区雨水利用工程技术规范》（GB 50400-2006）；
<Engineering technical code for rain utilization in building and sub-district> (GB 50400-2006);

深圳市地方标准 Shenzhen local standards:

- 《雨水利用工程技术规范》（SZDB/Z 49-2011）
< Engineering technical code for rainwater utilization >（SZDB/Z 49-2011）
- 《深圳市再生水、雨水利用水质规范》（SZJG32-2010）
< Water quality specifications for reclaimed water & stormwater utilization in Shenzhen>（SZJG32-2010）
- 《深圳市低冲击开发技术基础规范》（在编）
< The basic technical code for Low Impact Development in Shenzhen >

□ 《雨水利用工程技术规范》

< Engineering technical code for rainwater utilization >

- 规定了雨水利用工程的系统组成、设施种类以及设计准则。
system composition, facility species, and design criteria of rainwater utilization.
- 比较详细的给出了径流污染控制、雨水入渗和雨水收集利用的设计方法。
design methods of runoff pollution control, rainwater infiltration, and rainwater collection and utilization.
- 并以附录的形式给出径流污染控制设施（包括雨水滞留塘、雨水湿地、雨水过滤设施、植被草沟）的示意图。
provide schematic diagrams of runoff pollution control facilities (rainwater detention & retention pond, rainwater wetland, rainwater infiltration practices, vegetated swale) by the form of appendix.

❑ 《深圳市低冲击开发技术基础规范》(在编) < The basic technical code for Low Impact Development in Shenzhen >

- 第一部低影响开发技术规范。

The first LID technical code in domestic.

- “实施低冲击开发的项目，其规划和设计阶段应包括低冲击开发的内容。低冲击开发设施应与项目主体工程同时规划，同时设计，同时施工，同时使用”。

“LID concept should be involved in planning and design phases in LID projects, and the LID facilities should be designed, constructed and used simultaneously with the main projects”.

- 规范附录部分提供了低影响开发设计表、设计资料、常用材料要求、常用低影响开发设计模型和工程性低影响开发设施大样图，并给出低影响开发设计案例。

LID design tables, LID design materials, common material requirements, common LID design model, LID facilities diagrams and LID design case were provided in appendix.

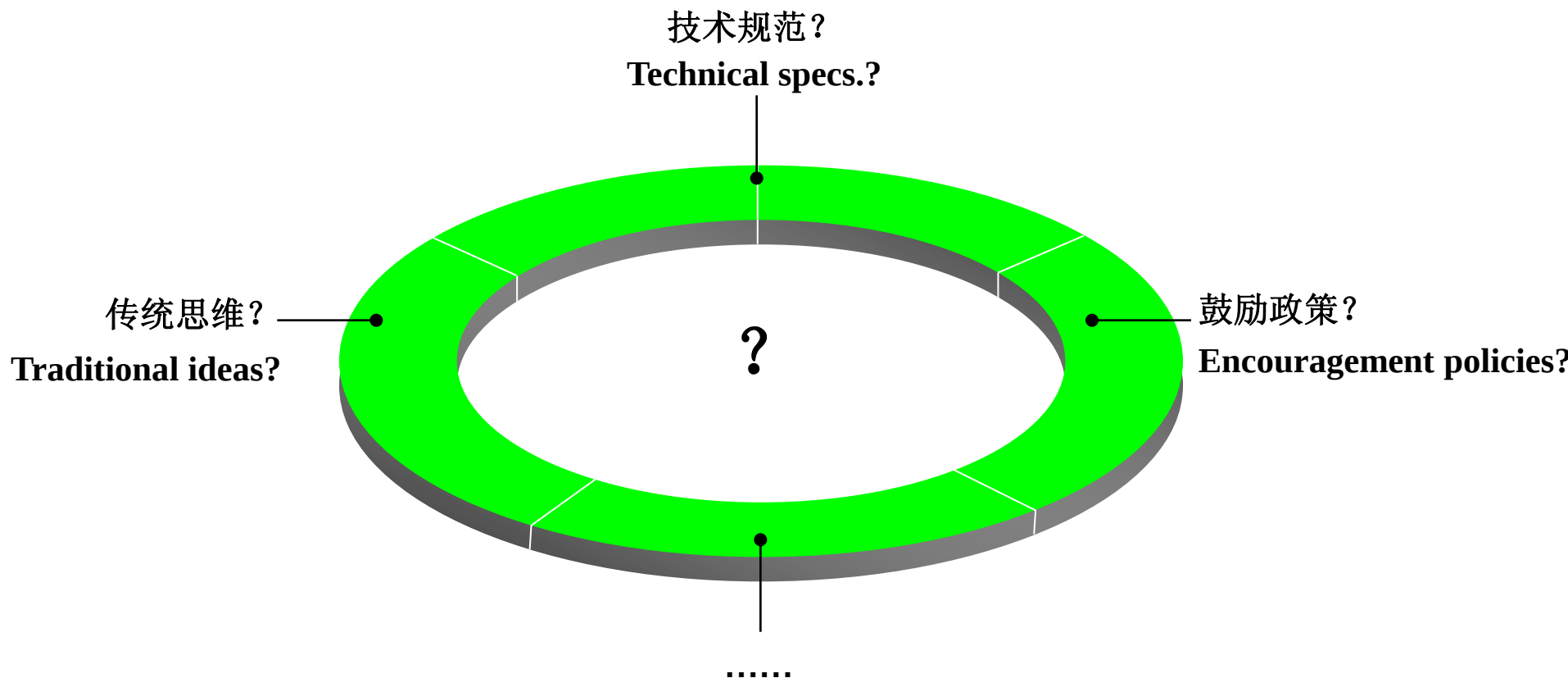


挑战与展望

Challenges and prospects

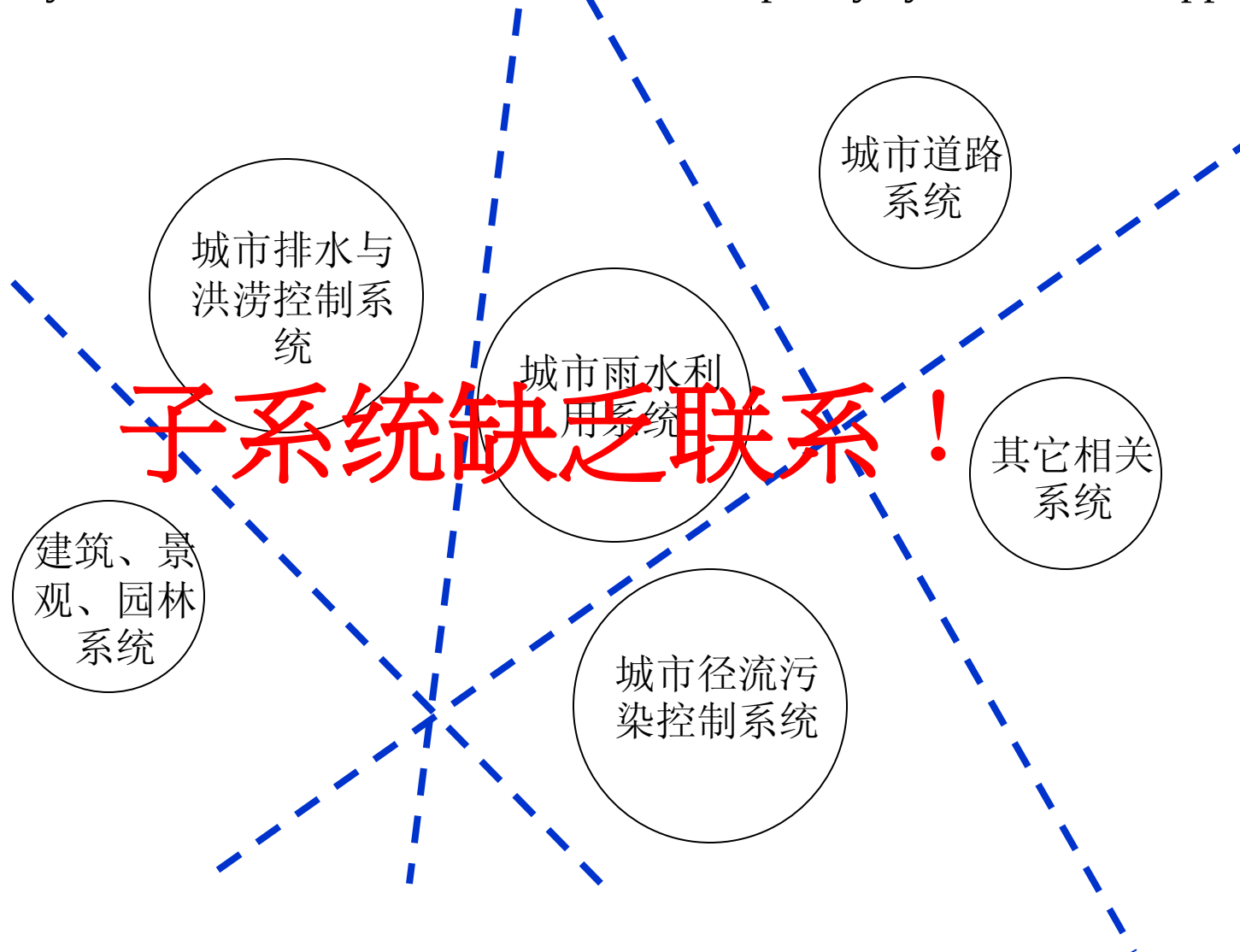
与美国等国相比，我们低冲击开发的应用推广仍较为困难。

We are facing many challenges of LID application and populization.



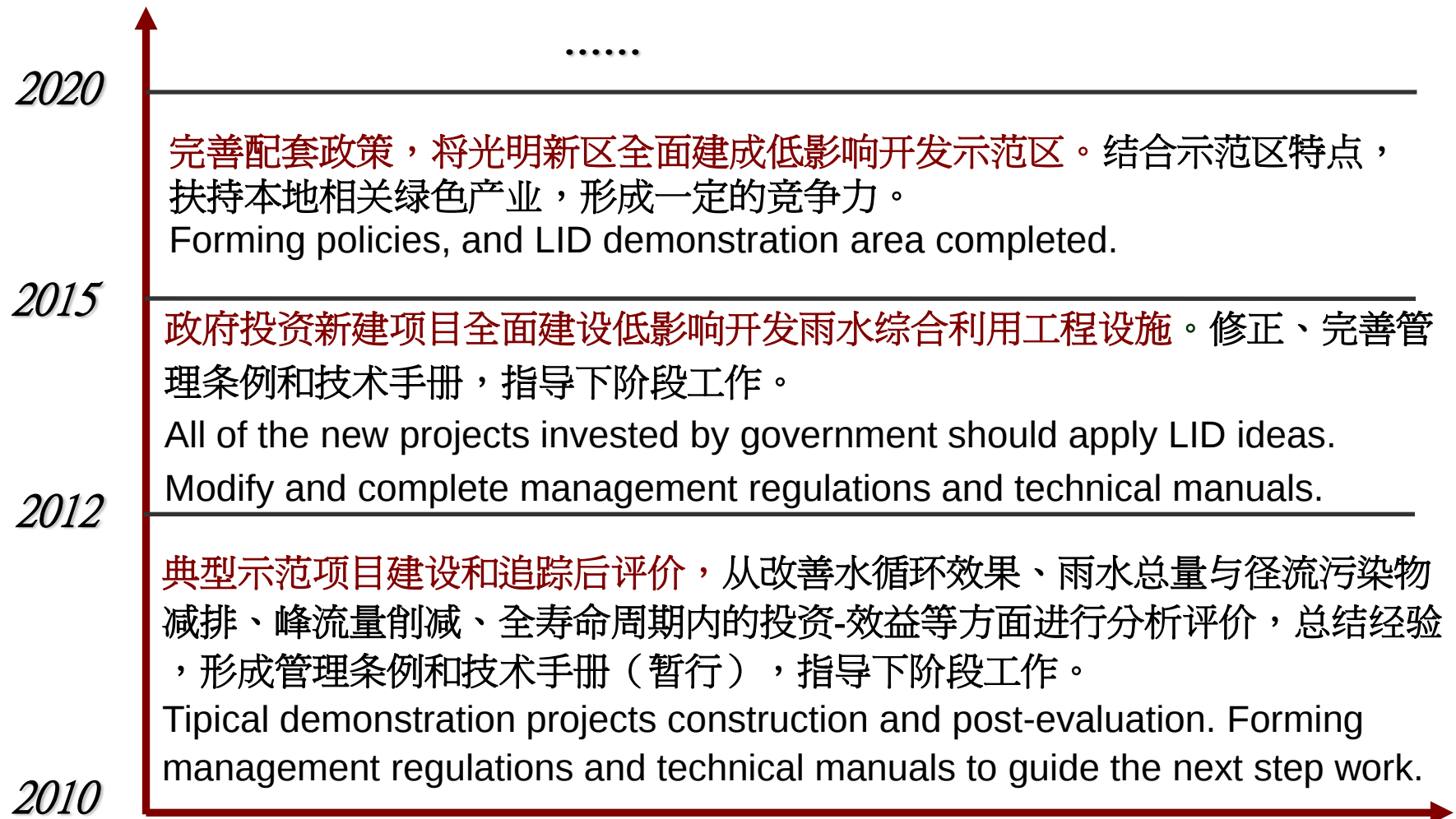
与美国等国相比，我们低冲击开发的应用推广仍较为困难。

How to form systematic mechanism, framework, and policy system of LID application?



- 在现有研究的基础上加快光明低影响开发示范区的创建。

LID demonstration area creating steps.



- 不断总结经验，制订、修改低影响开发相关标准规范。

Summing up experience by means of LID demonstration area founding, meanwhile, modify, perfect and make LID standards and specs..

- 探索制订低影响开发相关政策，为低影响开发模式的推广应用提供支持。

Establish LID policies and regulations on basis of LID demonstration area and LID basic research.

- 加快低影响开发单项技术的研究与示范，产、学、研相结合，开发适合本地气候特征的低影响开发单项技术设施。

Speed up localization of LID facilities and development of LID facilities suitable for southern climate.

- 加强技术普及和宣传，使各层次相关从业人员能够接受低影响开发理念。

Strengthen the popularization of LID idea to make it been accepted by each level relative managers and technicians.

Thank you