شرکت آب و فاضلاب استان اصفهان
Water & Waste Water Company of Isfahan Province

مهندسین مشاور طرح و تحقیقات آب و فاضلاب
Tarh va Tahghighat Ab va Fazelab
(Water & Wastewater Consulting Engineers)

Presentation Title:
Experiences and Challenges in Cleaning, Inspection and Rehabilitation of Wastewater Collection Networks
(Isfahan Finance Project)

Presenters:
Bashir Karimi
Alireza Kamranian

Conference: Sustainable Wastewater Operations: Lessons, Challenges, and the Roadmap
Date: September 8–10, 2026

معاونت تولیدی، فنی و زیربنایی
امور پیمانکاران و مشاوران

ریاست جمهوری
سازمان برنامه و بودجه کشور

شماره: ۵۳۶۷۴
تاریخ: ۱۴۰۱/۰۲/۰۸

گواهینامه صلاحیت خدمات مشاوره

جناب آقای عباس پیراینده
مدیرعامل محترم شرکت مهندسین مشاور طرح و تحقیقات آب و فاضلاب اصفهان
شناسه ملی ۱۰۲۶۰۲۵۷۹۱۲

به استناد تصویب نامه شماره ۲۰۶۳۷/ت۲۸۴۳۷هـ مورخ۱۳۸۳/۴/۲۳هیأت محترم وزیران و اصلاحات بعدی، با توجه به احراز شرایط لازم و تأیید صلاحیت در سامانه جامع تشخیص صلاحیت عوامل نظام فنی و اجرایی، بدین وسیله صلاحیت آن شرکت برای انجام امور مشاوره به شرح زیر اعلام می گردد.

پایه	تخصص	ظرفیت
۳	ایمنی و کاهش خطرات و پدافند غیر عامل	تعداد ۴ کار مجاز
۲	نقشه برداری زمینی	تعداد ۵ کار مجاز
۳	محیط زیست	تعداد ۴ کار مجاز
۳	خدمات اقتصادی	تعداد ۴ کار مجاز
۲	تاسیسات آب و فاضلاب	تعداد ۵ کار مجاز
۲	تکرار تاسیسات آب و فاضلاب	تعداد ۵ کار مجاز
۱	تاسیسات آب و فاضلاب	تعداد ۶ کار مجاز
۳	شبکه های آبیاری و زهکشی	تعداد ۴ کار مجاز
۱	تاسیسات آب و فاضلاب (مدیریت طرح)	تعداد ۱ کار مجاز
۲	نقشه برداری زمینی (مدیریت طرح)	تعداد ۱ کار مجاز

این گواهینامه تا پایان دوره ارزشیابی و حداکثر تا تاریخ ۱۴۰۵/۰۶/۳۱ معتبر بوده و همواره ملاک اعتبار آن، اطلاعات مندرج در سامانه sajar.mporg.ir است.

«شرکت آب و فاضلاب اصفهان» (۳۰درصد) و شرکت «وزارت کشور» (۳۲درصد) و شرکت «آستان قدس رضوی» (۳۸درصد) سهامدار عمده این شرکت می باشند و همچنین رعایت تبصره های (۱) و (۲) بند «ت» ماده (۳) آیین نامه اجرایی بند «الف» ماده (۲۶) قانون برگزاری مناقصات توسط آن شرکت الزامی است.

ارائه خدمات مدیریت طرح در تخصص های «تاسیسات آب و فاضلاب» با پایه ۱ «نقشه برداری زمینی» با پایه ۲ توسط دارنده این گواهینامه مجاز است.

امور مشاوران و پیمانکاران

- رعایت قانون برگزاری مناقصات، آیین نامه های اجرایی آن، ظرفیت کاری مجاز و بخشنامه شماره ۱۴۰۱/۷۳۰۳۹ مورخ ۱۴۰۱/۰۲/۲۱ با موضوع مدیریت تعارض منافع و جلوگیری از تبانی در ارجاع کار ضروری است.

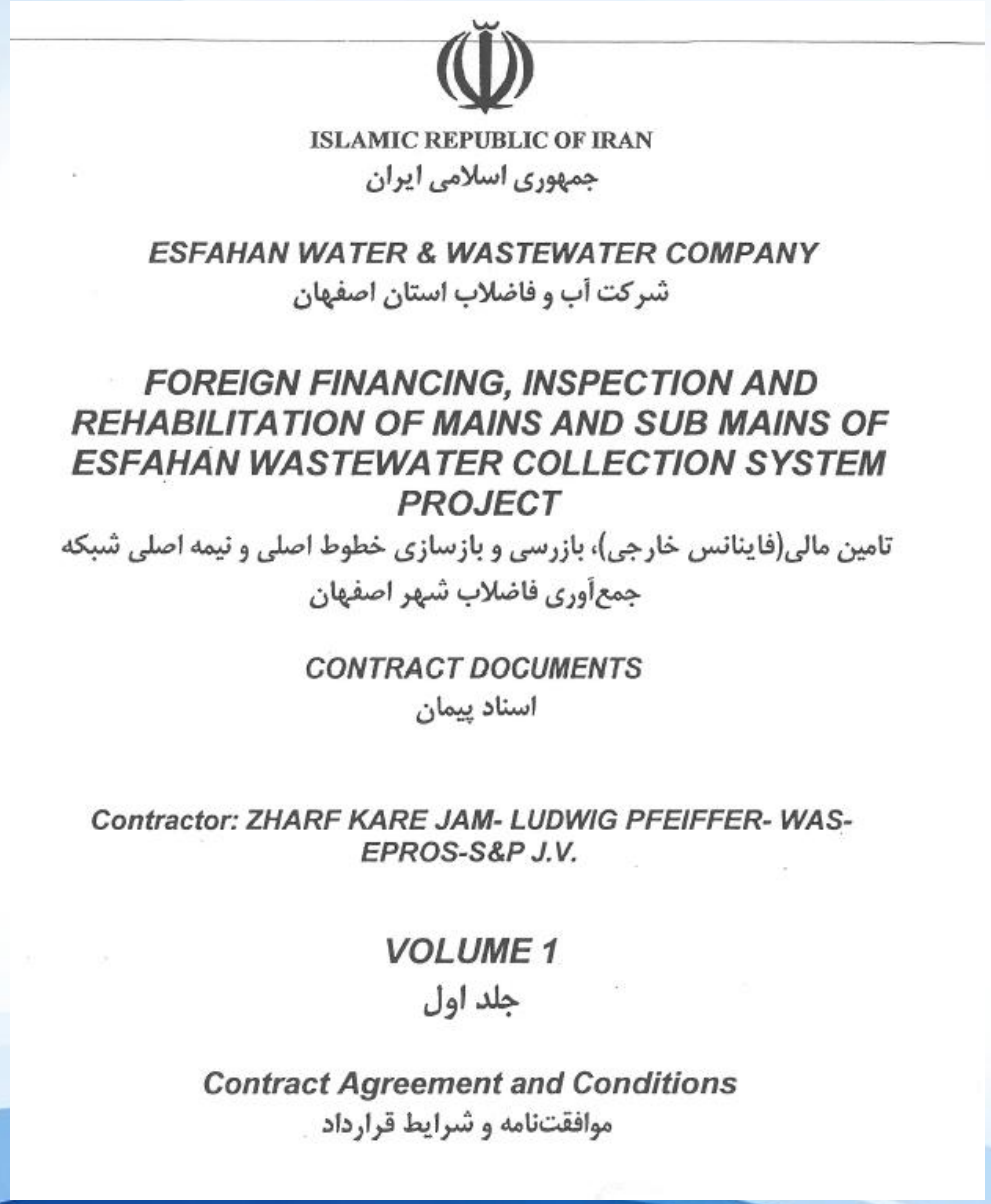
Tarh va Tahghighat Ab va fazelab
(Water and Wastewater Consulting Engineers)

- **Established in 1980**, with the mission of providing engineering consultancy services in planning, design, and supervision of water and wastewater infrastructure projects.
- The company also undertakes **research and development** in the field of water and wastewater engineering, supporting sustainable development and efficient operation of related infrastructure.
- Today, the consultancy brings together **more than 350 engineers, specialists, and PhD-level experts** fo estirepxe dna egdelwonk eht yb detnemelpmoc , .srosseforp ytisrevinu dehsiugntisid
- Backed by **over 46 years of professional experience** llew si ynapmoc eht , reviled ot denotiisop**state-of-the-art and highly specialized consultancy services**.rotces retawetsaw dna retaw eht ssorca

ARIAN TUV PASARGAD
ISO 45001:2018
Certificate Nr. 24-Q-1002569-TIC

ARIAN TUV PASARGAD
ISO 9001:2015
Certificate Nr. 24-Q-1002569-TIC

ARIAN TUV PASARGAD
ISO 14001:2015
Certificate Nr. 24-E-1002569-TIC



ISLAMIC REPUBLIC OF IRAN
جمهوری اسلامی ایران

ESFAHAN WATER & WASTEWATER COMPANY
شرکت آب و فاضلاب استان اصفهان

FOREIGN FINANCING, INSPECTION AND REHABILITATION OF MAINS AND SUB MAINS OF ESFAHAN WASTEWATER COLLECTION SYSTEM PROJECT
تامین مالی(فاینانس خارجی)، بازرسی و بازسازی خطوط اصلی و نیمه اصلی شبکه جمع‌آوری فاضلاب شهر اصفهان

CONTRACT DOCUMENTS
اسناد پیمان

Contractor: ZHARF KARE JAM- LUDWIG PFEIFFER- WAS-EPROS-S&P J.V.

VOLUME 1
جلد اول

Contract Agreement and Conditions
موافقت‌نامه و شرایط قرارداد

Project Overview

Employer: Isfahan Water and Wastewater Company (IWWC)

Consultant :

Tarh va Tahghighat Ab va fazelab
(Water and Wastewater Consulting Engineers) – Pars Jouyab Consortium

Contractor: Jorfkar Jam –BCEGI Consortium

Contract Value€ :46.09 million

Scope of Work:

Sewer Network InspectionVTCC Inspection & Telemetry and **Rehabilitation / Renewal** of the existing sewer infrastructure

Chapter No.	Total Price (EURO)
1-Pipejacking	13,193,894
2-CCTV	14,408,413
3-Flowmetry	2,142,492
4-Telemetry System (without spare parts)	1,616,903
5-Rehabilitation	11,490,572
6-Mobilization and Demobilization	1,358,953
7-Test operation (2 years)	800,000
8-Training of Client personnel	80,000
Total (items 1-8)	**45,091,227**
9-Provisional Sum	1,000,000
Total	**46091227**

Sewer System Management process

Technical Standards and Reference Guidelines

Sewer System Management process

DEUTSCHE NORM April 2008

DIN EN 752

DIN

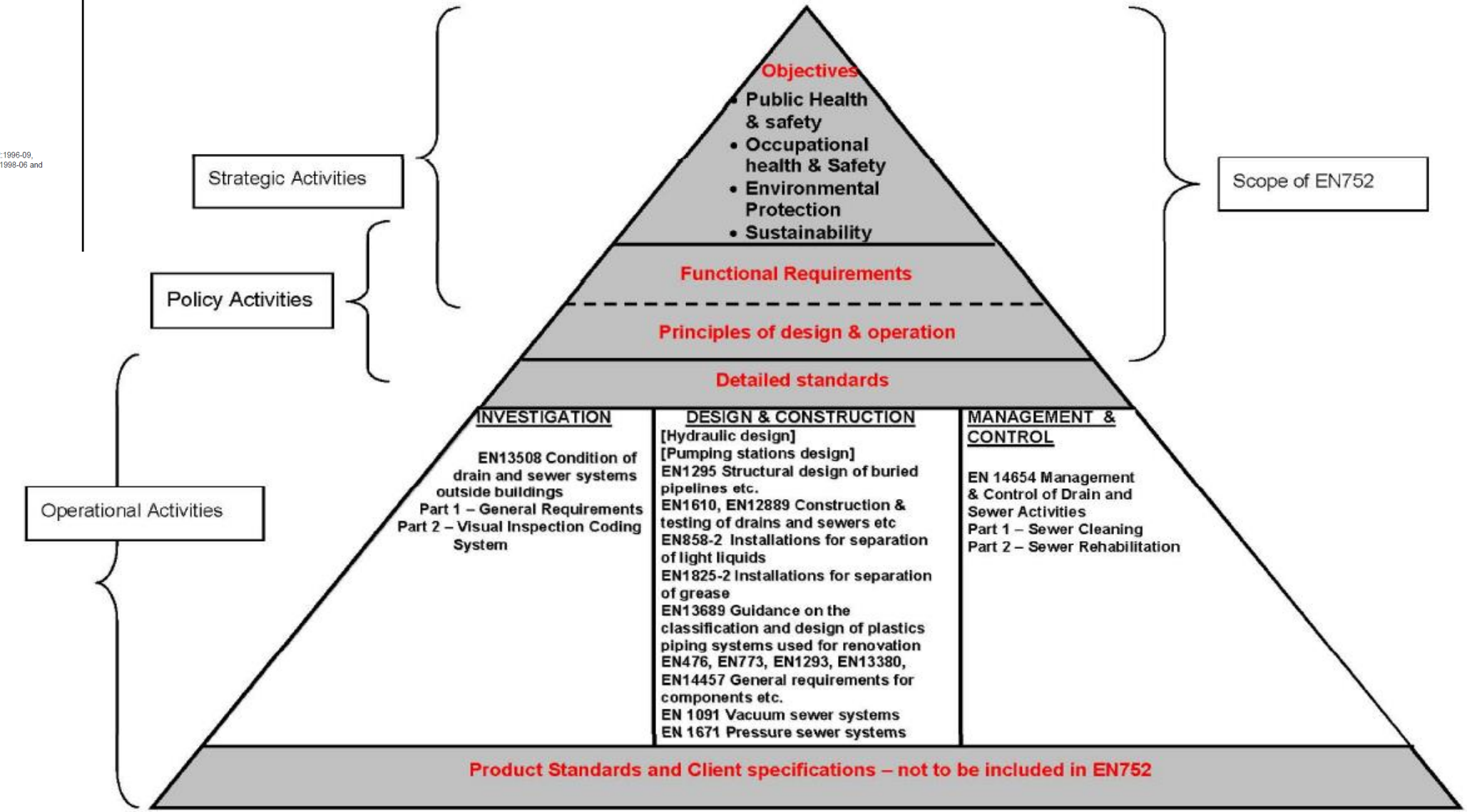
ICS 93.030 Supersedes: see below

Drain and sewer systems outside buildings
English version of DIN EN 752:2008-04

Entwässerungssysteme außerhalb von Gebäuden
Englische Fassung DIN EN 752:2008-04

Supersedes DIN EN 752 Supplement 1:1999-10, DIN EN 752-1:1996-01, DIN EN 752-2:1996-09, DIN EN 752-3:1996-09, DIN EN 752-4:1997-11, DIN EN 752-5:1997-11, DIN EN 752-6:1998-06 and DIN EN 752-7:1998-06

DIN EN 752:2008-04
EN 752:2008 (E)



DEUTSCHE NORM April 2008

DIN EN 752

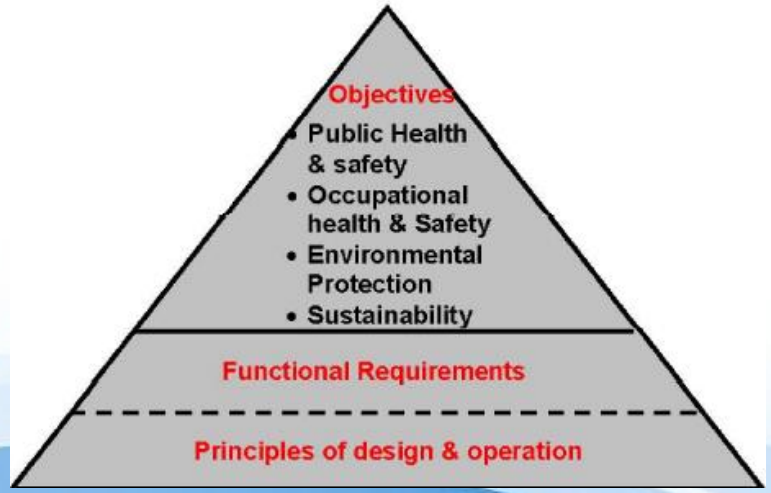
DIN

ICS 93.030 Supersedes: see below

Drain and sewer systems outside buildings
English version of DIN EN 752:2008-04

Entwässerungssysteme außerhalb von Gebäuden
Englische Fassung DIN EN 752:2008-04

Supersedes DIN EN 752 Supplement 1:1999-10, DIN EN 752-1:1996-01, DIN EN 752-2:1996-09, DIN EN 752-3:1996-09, DIN EN 752-4:1997-11, DIN EN 752-5:1997-11, DIN EN 752-6:1998-06 and DIN EN 752-7:1998-06



DIN EN 752:2008-04
EN 752:2008 (E)

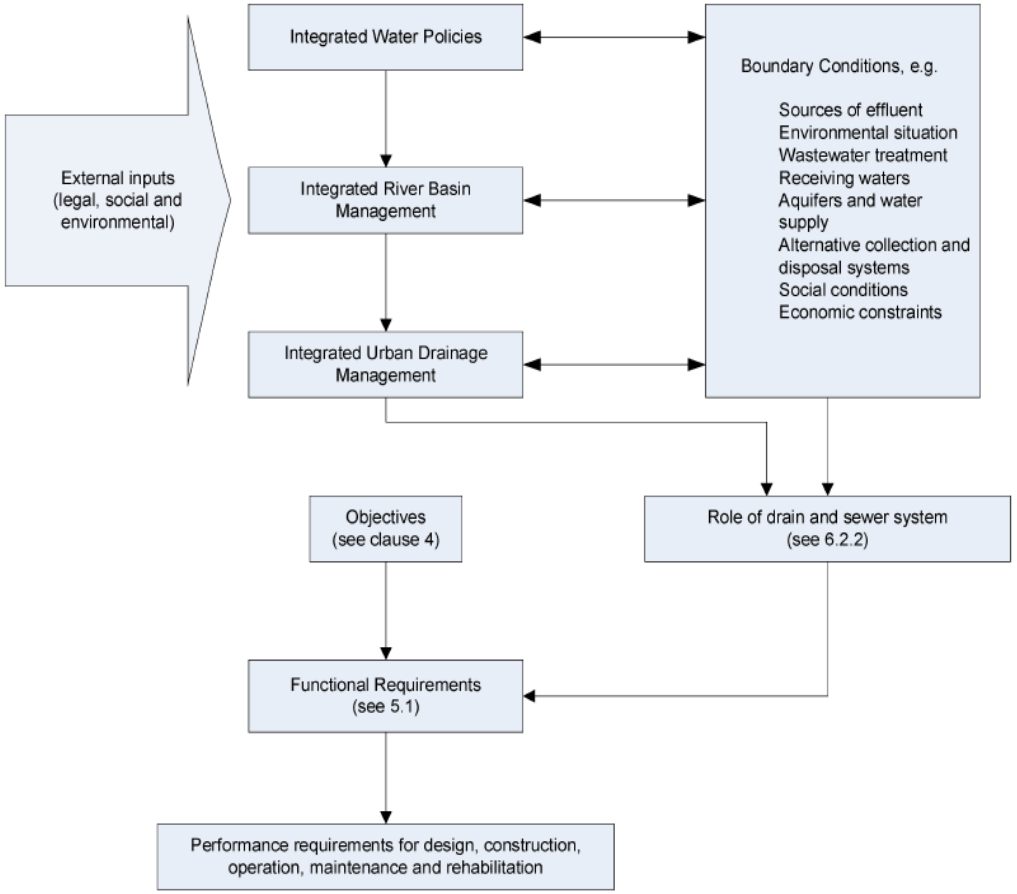


Figure 4 — Process for determining performance requirements

DEUTSCHE NORM April 2008

DIN EN 752

DIN

ICS 93.030 Supersedes: see below

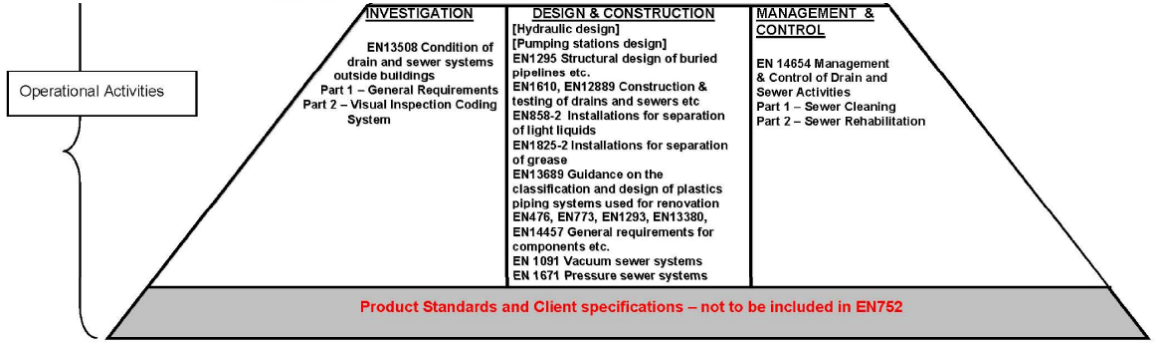
Drain and sewer systems outside buildings
English version of DIN EN 752:2008-04

Entwässerungssysteme außerhalb von Gebäuden
Englische Fassung DIN EN 752:2008-04

Supersedes DIN EN 752 Supplement 1:1999-10, DIN EN 752-1:1996-01, DIN EN 752-2:1996-09, DIN EN 752-3:1996-09, DIN EN 752-4:1997-11, DIN EN 752-5:1997-11, DIN EN 752-6:1998-06 and DIN EN 752-7:1998-06

Integrated Sewer System Management

DIN EN 752:2008-04
EN 752:2008 (E)



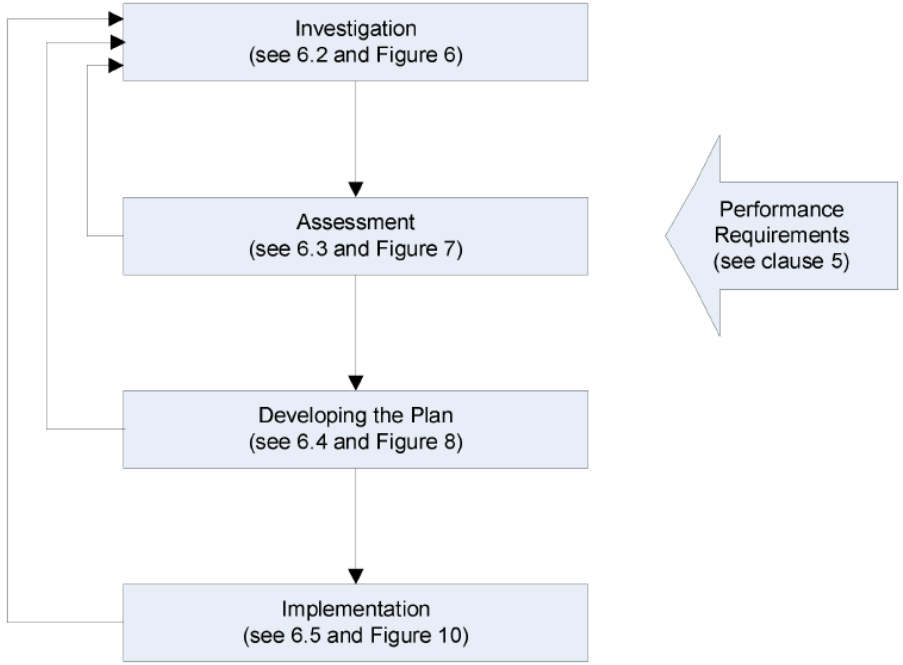
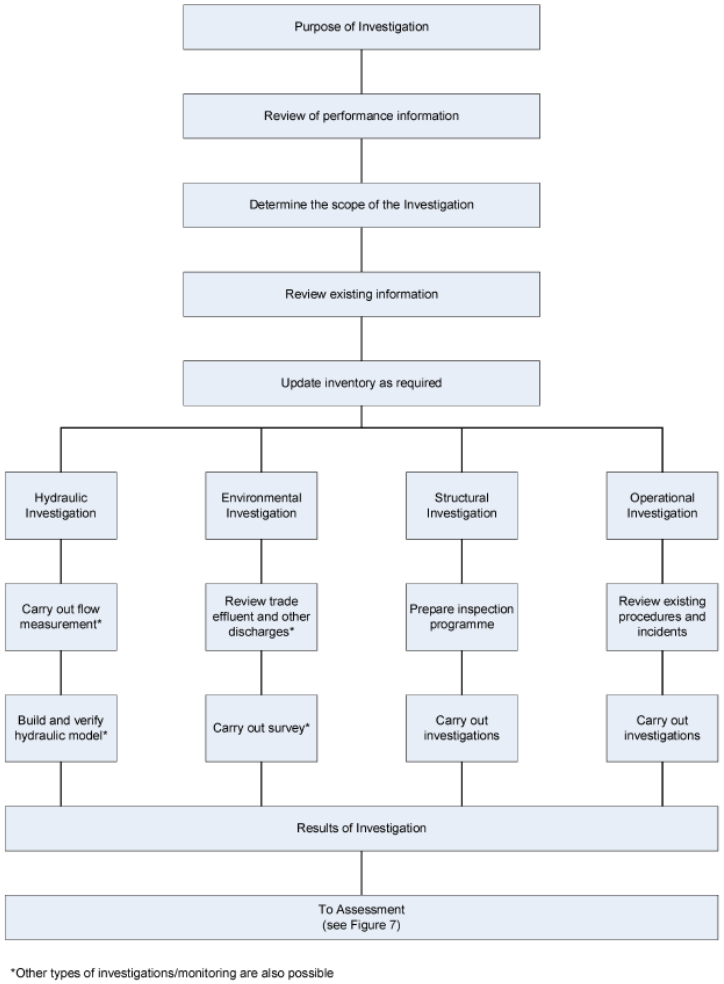


Figure 5 — Integrated Sewer System Management Process

BSI Standards Publication

Investigation and assessment of drain and sewer systems outside buildings

Part 1: General Requirements



*Other types of investigations/monitoring are also possible

Figure 6 — Process for investigation

BSI Standards Publication

Investigation and assessment of drain and sewer systems outside buildings
Visual inspection coding system

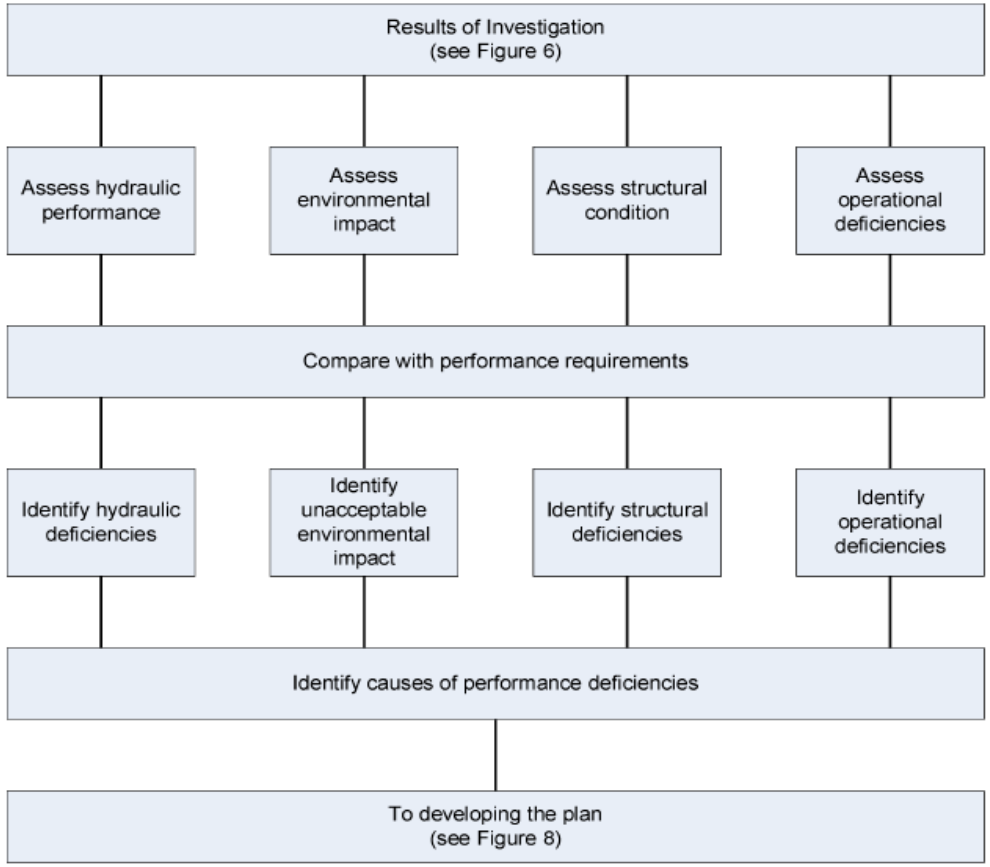


Figure 7 — Process for assessment

BS EN 13508-1:2012

BSI Standards Publication

Investigation and assessment of drain and sewer systems outside buildings

Part 1: General Requirements

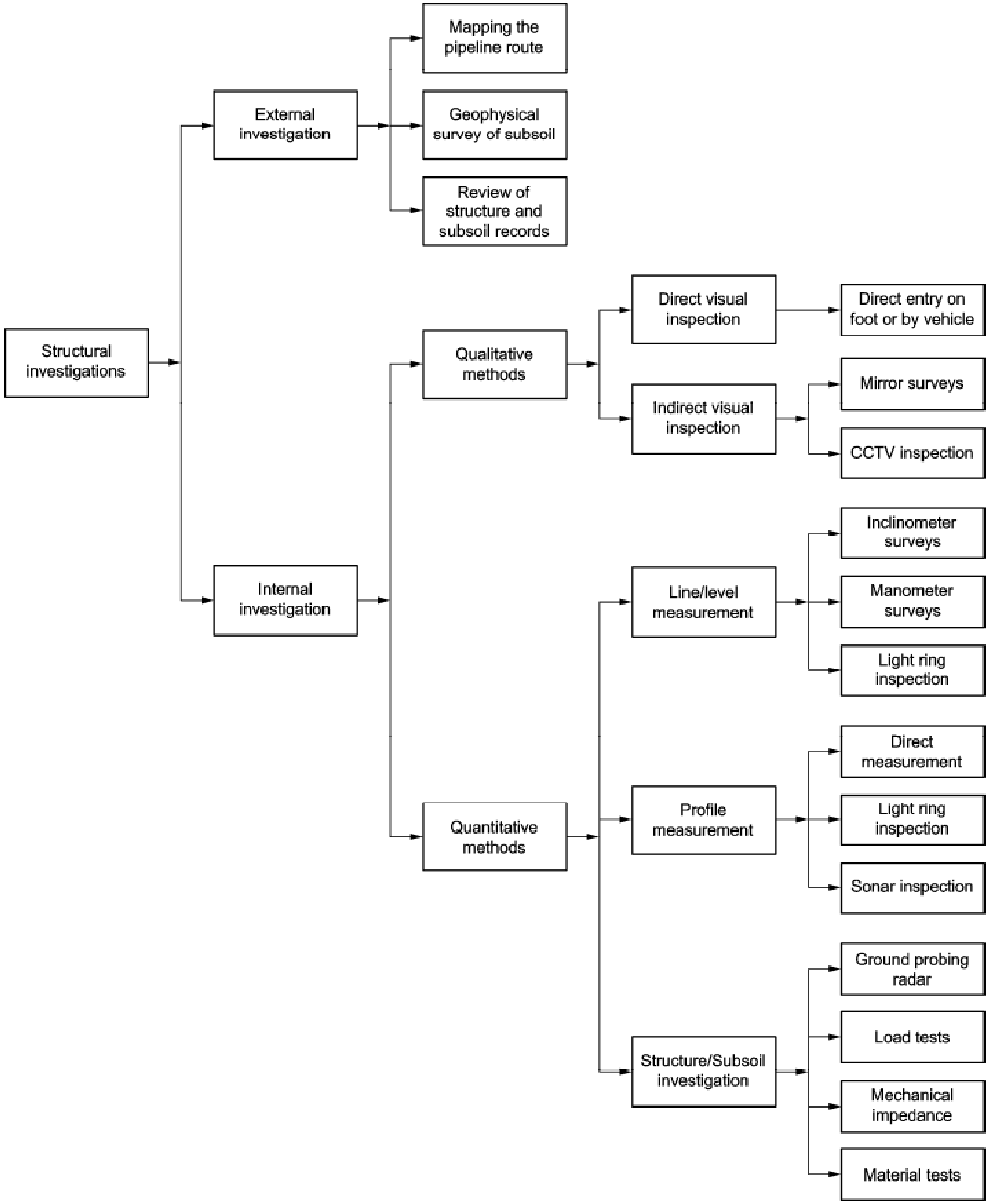


Figure 4 — Structural investigation methods

BS EN 13508-2:2003+A1:2011

BSI Standards Publication

Investigation and assessment of drain and sewer systems outside buildings
Visual inspection coding system

BS EN 13508-1:2012

BSI Standards Publication

Investigation and assessment of drain and sewer systems outside buildings

Part 1: General Requirements

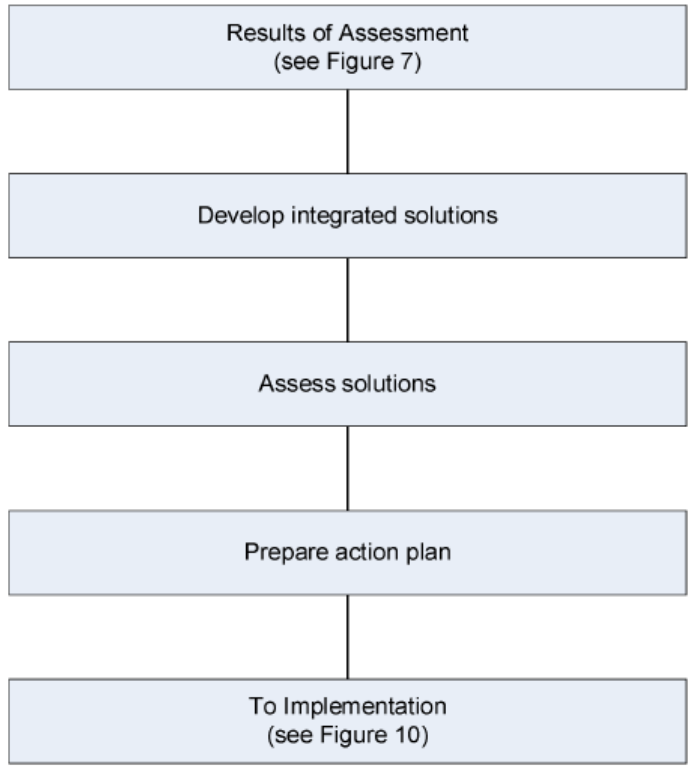


Figure 8 — Process for developing the plan

BS EN 13508-2:2003+A1:2011

BSI Standards Publication

Investigation and assessment of drain and sewer systems outside buildings
Visual inspection coding system

INTERNATIONAL STANDARD

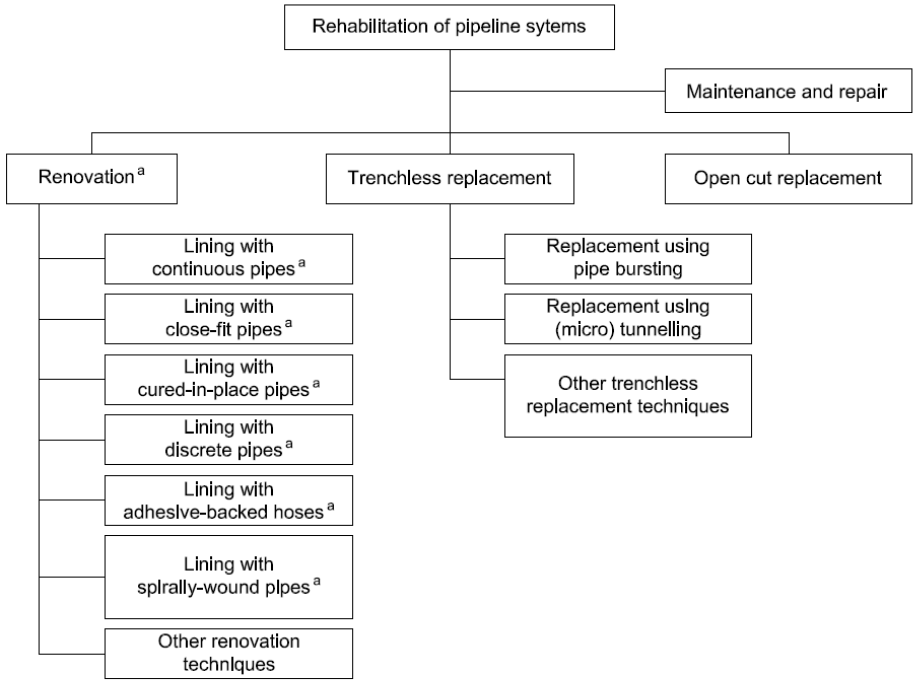
ISO 11295

First edition
2010-03-01

Classification and information on design of plastics piping systems used for renovation

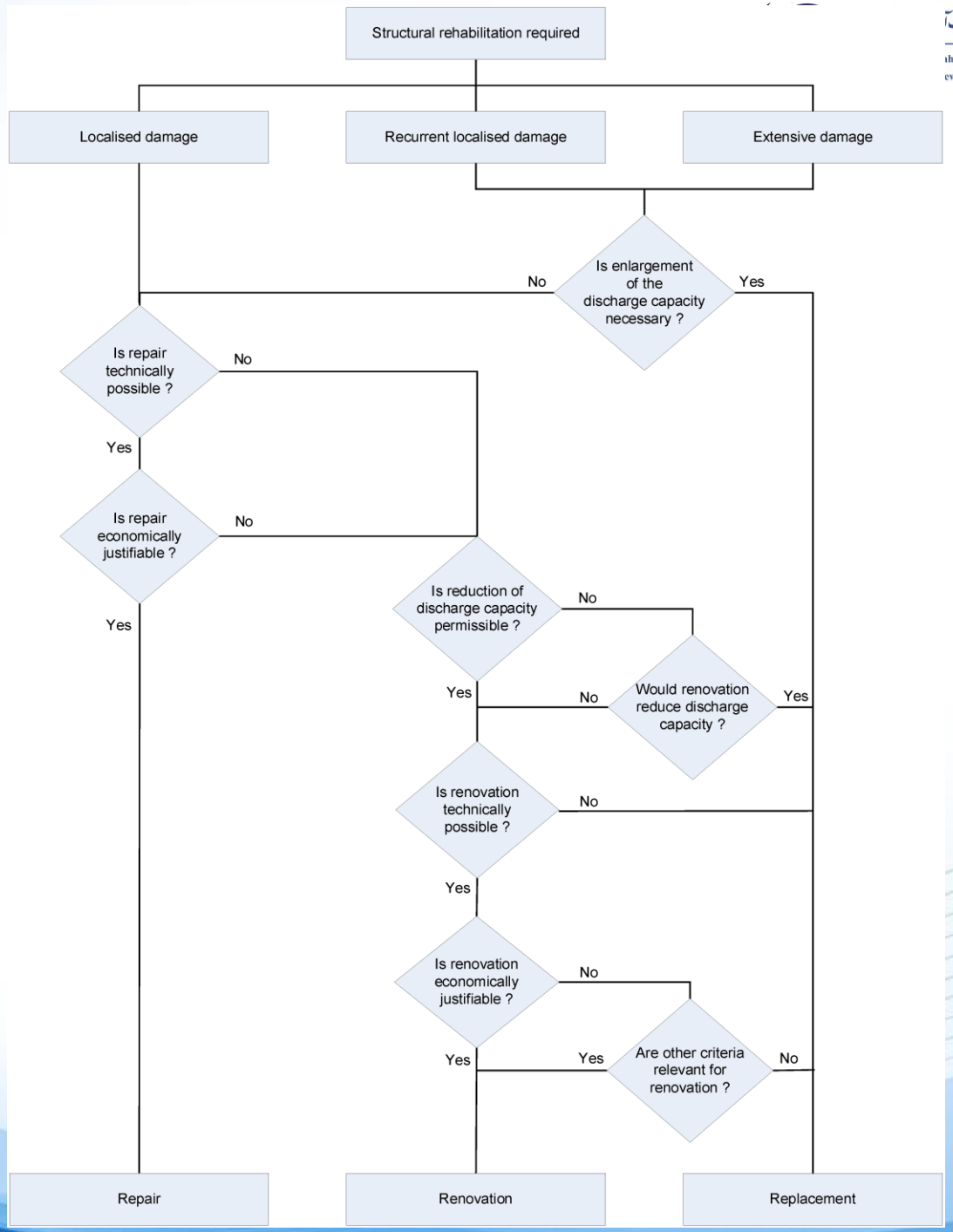
Classification et informations relatives à la conception des systèmes de canalisations en plastique destinés à la rénovation

ISO 11295:2010(E)



a This International Standard is applicable.

Figure 1 — Renovation technique families using plastics pipes defined in the overall context of rehabilitation of pipeline systems



BS EN 13508-1:2012

BSI Standards Publication

Investigation and assessment of drain and sewer systems outside buildings

Part 1: General Requirements

BS EN 13508-2:2003+A1:2011

BSI Standards Publication

Investigation and assessment of drain and sewer systems outside buildings
Visual inspection coding system

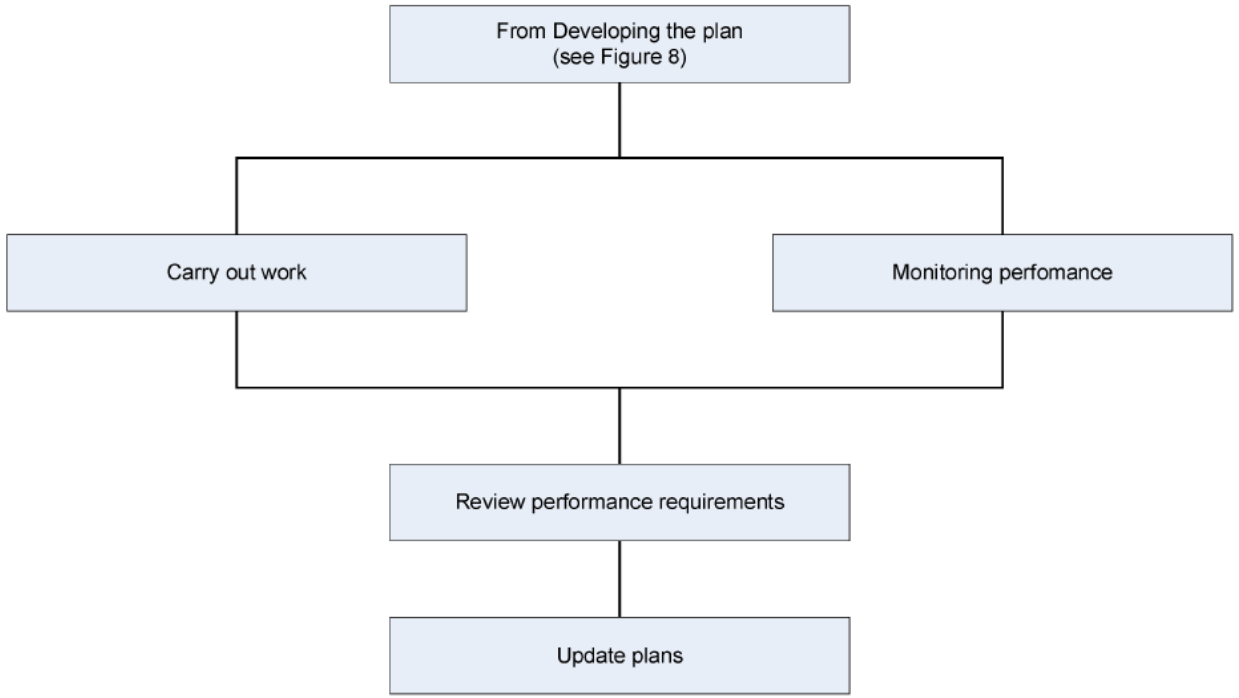


Figure 10 — Process for implementation

EUROPEAN STANDARD **EN 14654-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM June 2014

ICS 93.030 Supersedes EN 14654-1:2005

English Version

Management and control of operational activities in drain and sewer systems outside buildings - Part 1: Cleaning

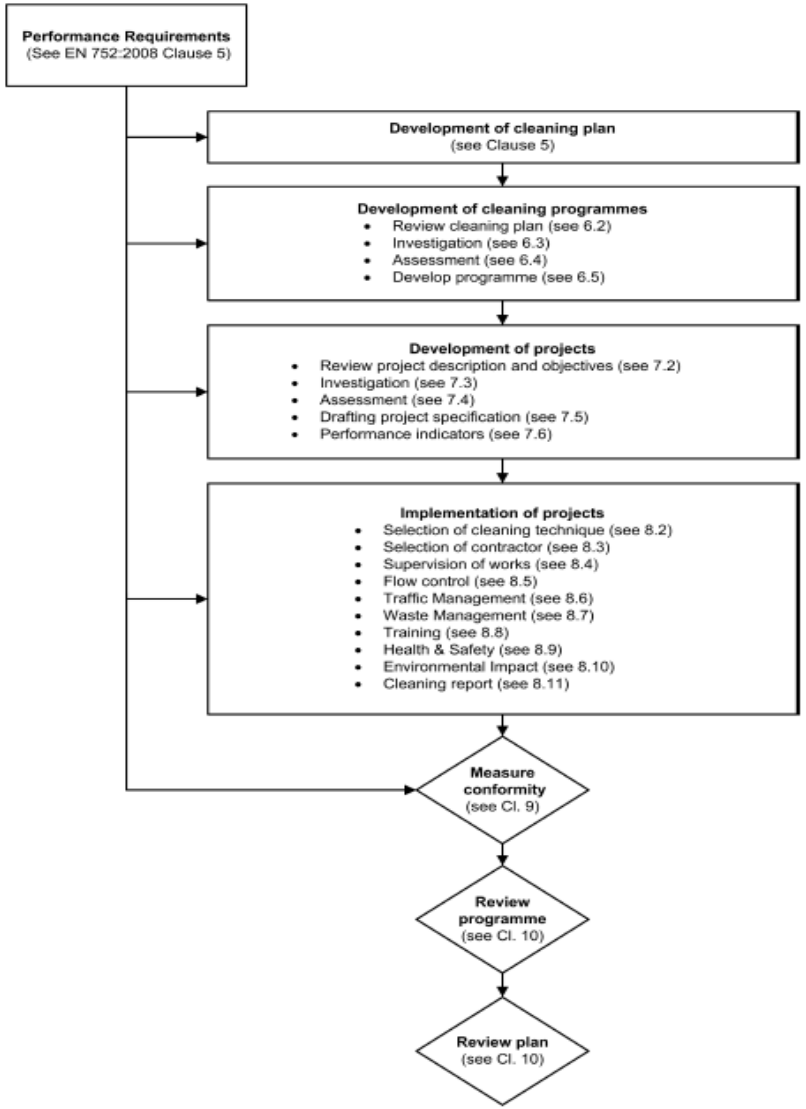


Figure 2 — Summary of the sewer cleaning management and control process

BS EN 14654-2:2013

BSI Standards Publication

Management and control of operational activities in drain and sewer systems outside buildings

Part 2: Rehabilitation

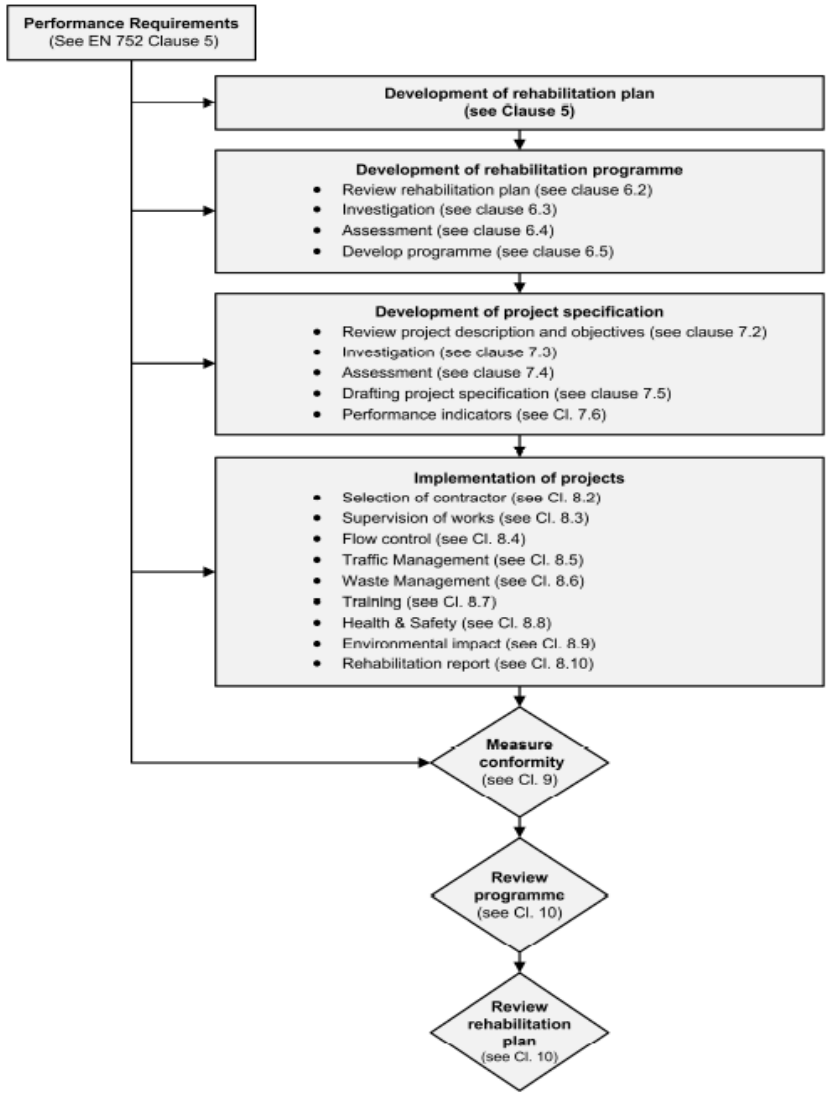


Figure 2 — Summary of the rehabilitation management and control process

Technical References and Standards

INTERNATIONAL STANDARD **ISO 11296-4**

First edition
2009-11-01

Corrected version
2010-06-01

Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks —

Part 4: Lining with cured-in-place pipes

Systèmes de canalisations en matières plastiques pour la rénovation des réseaux d'assainissement gravitaires enterrés —

Partie 4: Tubage continu par tubes polymérisés sur place

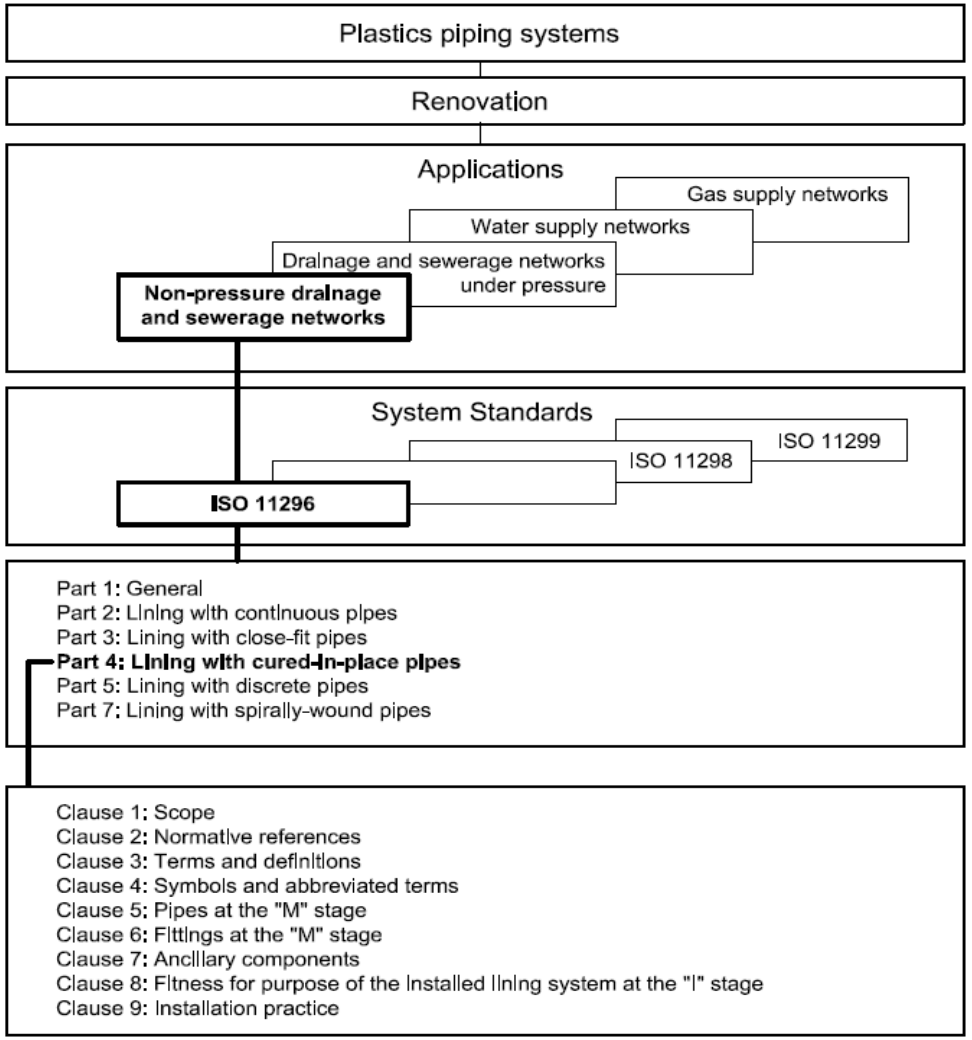


Figure 1 — Format of the renovation System Standards

GERMAN DWA Set of Rules

plus further publications and information

English Version

April 2014

Sponsored by the German Federal Environmental Foundation
DBU
Deutsche Bundesstiftung Umwelt

DWA

German DWA Set of Rules – Publications – Information

ATV-M 143-6E
Inspection, Repair, Rehabilitation and Replacement of Sewers and Drains – Part 6: Leak Testing of Existing, Earth Covered Sewers and Drains and Shafts Using Water, Air Overpressure and Vacuum

DWA-M 143-14E
Rehabilitation of Drain and Sewer Systems Outside Buildings – Part 14: Rehabilitation Strategies

DWA-M 143-17E
Rehabilitation of Drain and Sewer Systems Outside Buildings – Part 17: Coating Wastewater Conduits, Pipes and Shafts with Cement-bonded Mortars

DWA-M 144-3E New
Supplementary Technical Contract Conditions (ZTV) for the Rehabilitation of Drainage Systems outside of Buildings – Part 3: Renovation with Hose Liner Process (locally cured hose liner) for Sewers

ATV-DVWK-M 145E
Setting-up and Application of Sewer Information Systems

DWA-M 149-2E
Conditions and Assessment of Drain and Sewer Systems Outside Buildings — Part 2: Visual Inspection Coding System

DWA-M 149-3E
Conditions and Assessment of Drain and Sewer Systems Outside Buildings — Part 3: Condition Classification and Assessment

DWA-M 149-4E
Conditions and Assessment of Drain and Sewer Systems Outside Buildings — Part 4: Detection of Bedding Defects and Cavities by Means of Geophysical Techniques

DWA-M 153E
Recommended Actions for Dealing with Stormwater

ATV-DVWK-A 157E
Sewer System Structures

ATV-A 161E
Structural Calculation of Driven Pipes

DWA-M 180E
Framework for Planning of Real Time Control of Sewer Networks

ATV-DVWK-M 197E
Invitation to Tender for Sewer Cleaning Services Using the High Pressure Flushing Process

ATV-DVWK-A 198E
Standardisation and Derivation of Dimensioning Values for Wastewater Facilities

DWA-A 199-1E New
Service and Operating Instructions for the Personnel of Wastewater Systems – Part 1: Service Instructions for the Personnel of Wastewater Systems

ATV-A 200E
Principles for the Disposal of Wastewater in Rurally Structured Areas

EPA
United States Environmental Protection Agency
EPA/600/R-09/049 | May 2009 | www.epa.gov/nrmrl

Condition Assessment of Wastewater Collection Systems

WHITE PAPER

Office of Research and Development
National Risk Management Research Laboratory - Water Supply and Water Resources Division

EPA
United States Environmental Protection Agency
EPA/600/R-10/078 | July 2010 | www.epa.gov /nrmrl

State of Technology for Rehabilitation of Wastewater Collection Systems

Office of Research and Development
National Risk Management Research Laboratory - Water Supply and Water Resources Division

EPA
United States Environmental Protection Agency
EPA/600/R-11/078 | July 2011 | www.epa.gov /nrmrl

Field Demonstration of Condition Assessment Technologies for Wastewater Collection Systems

Office of Research and Development
National Risk Management Research Laboratory - Water Supply and Water Resources Division

Designation: F 2019 – 03

An American National Standard

Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)[1]

This standard is issued under the fixed designation F 2019; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

Designation: F1216 – 09

An American National Standard

Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube[1, 2]

This standard is issued under the fixed designation F1216; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

Designation: F 1743 – 96 (Reapproved 2003)

An American National Standard

Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)[1]

This standard is issued under the fixed designation F 1743; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

PIPE CONDITION ASSESSMENT USING CCTV

PERFORMANCE SPECIFICATION GUIDELINE

October, 2014

CURED-IN-PLACE PIPE (CIPP) INSTALLATION

PERFORMANCE SPECIFICATION GUIDELINE (PSG)

July 2017

SEWER PIPE CLEANING

SPECIFICATION GUIDELINE

November, 2014

استاندارد ملی ایران
۱۸۰۹۸-۱
چاپ اول
۱۳۹۲

جمهوری اسلامی ایران
Islamic Republic of Iran
سازمان ملی استاندارد ایران
Iranian National Standardization Organization

INSO
18098-1
1st.Edition
2013

پلاستیک‌ها – سامانه‌های لوله‌گذاری برای نوسازی شبکه‌های زیرزمینی فاضلاب و زهکشی بدون فشار– قسمت ۱: کلیات

Plastics- piping systems for renovation of underground non-Pressure drainage and sewerage networks
Part1:General

ICS:23.040.20; 23.040.45; 91.140.80; 93.030

استاندارد ملی ایران
۱۸۳۴۳
چاپ اول
۱۳۹۳

جمهوری اسلامی ایران
Islamic Republic of Iran
سازمان ملی استاندارد ایران
Iranian National Standardization Organization

INSO
18343
1st.Edition
2014

طبقه‌بندی و اطلاعات مورد نیاز برای طراحی سامانه‌های لوله‌گذاری پلاستیکی مورد استفاده در نوسازی

Classification and information on design of plastics piping systems used for renovation

ICS: 23. 040.01

استاندارد ملی ایران
۱۸۰۹۸-۴
تجدید نظر اول
۱۳۹۸

جمهوری اسلامی ایران
Islamic Republic of Iran
سازمان ملی استاندارد ایران
Iranian National Standardization Organization

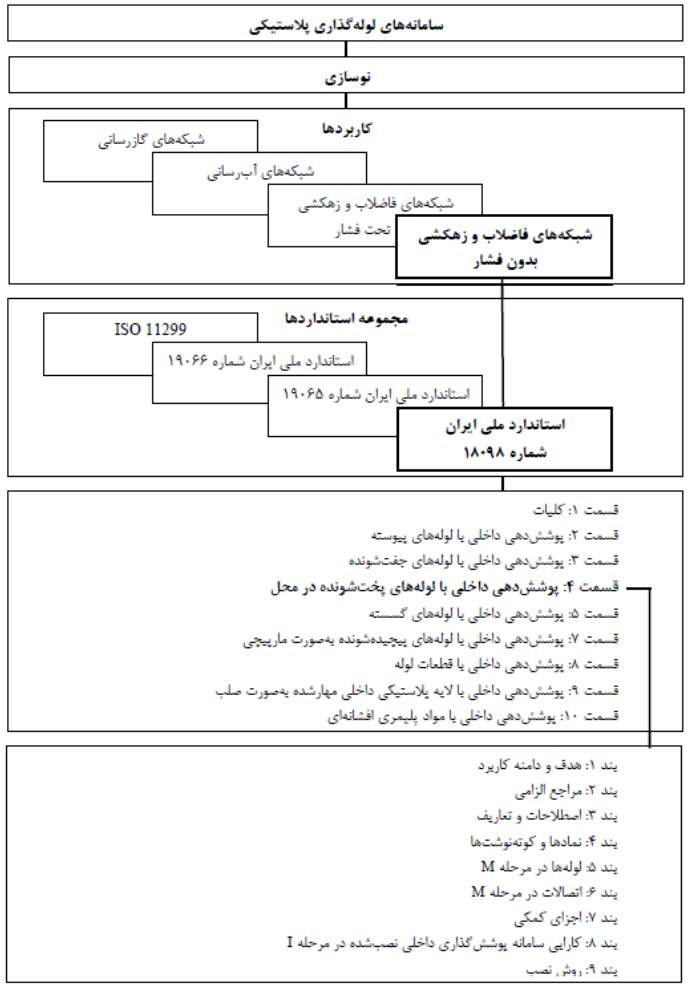
INSO
18098-4
1st Revision
2020
Modification of ISO 11296-4: 2018

سامانه‌های لوله‌گذاری پلاستیکی برای نوسازی شبکه‌های زیرزمینی فاضلاب و زهکشی بدون فشار– قسمت ۴: پوشش‌دهی داخلی با لوله‌های پخت‌شونده در محل

Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks-
Part 4: Lining with cured-in-place pipes

ICS: 93.030; 91.140.80; 23.040.20; 23.040.45

استاندارد ملی ایران شمارهٔ ۴-۱۸۰۹۸ (تجدید نظر اول): سال ۱۳۹۸



شکل ۱– قالب کلی مجموعه استانداردهای نوسازی

ردیف	نام استاندارد	عنوان	کاربرد	تهیه کننده	زبان نسخه اصلی
۱	ضابطه شماره ۶۷۷	دستورالعمل انجام عملیات ویدئومتری شبکه‌های فاضلاب	ویدئومتری شبکه فاضلاب	سازمان مدیریت و برنامه-ریزی کشور	فارسی
۲	SRM-٤ ed.	Sewerage Rehabilitation manual ۲۰۰۱-Vol۱	بازسازی شبکه فاضلاب	WRc	انگیسی
۳	ISO ۱۷۸	Plastics — Determination of flexural properties	تست لاینر CIPP	سازمان استاندارد جهانی	انگیسی-آلمانی
۴	EN ١٤٦٥٤-١	Management and Control of Operational in Drain and Sewer Systems Outsides Buildings-Part ۱-Cleaning	بازرسی و بازسازی شبکه فاضلاب	استاندارد اروپا	انگیسی
۵	EN ١٤٦٥٤-٢	Management and Control of Operational in Drain and Sewer Systems Outsides Buildings-Part ۲-Rehabilitation	بازرسی و بازسازی شبکه فاضلاب	استاندارد اروپا	انگیسی
۶	نشریه شماره ۵۲۰	راهنمای بهره‌برداری و نگهداری از شبکه‌های فاضلاب	بهره‌برداری شبکه فاضلاب	سازمان مدیریت و برنامه-ریزی کشور	فارسی
۷	MSCC-٤ed.	Manual of Sewer Condition Classification-۲۰۰٤	ویدئومتری شبکه فاضلاب	WRc	انگیسی
۸	MSCC-٥ed.	Manual of Sewer Condition Classification-۲۰۱۳	ویدئومتری شبکه فاضلاب	WRc	انگیسی
۹	DIBT Z.٤٢,٣,٣٥٠	Schlauchliner mit der Bezeichnung "SAERTEX-LINER	بازسازی شبکه فاضلاب	Deutsches Institut für Bautechnik	آلمانی
۱۰	DWA١٤٣-١	Rehabilitation of sewer systems outside buildings – Part ۱ : General and requirements	بازسازی شبکه فاضلاب	انجمن آب آلمان	آلمانی
۱۱	DWA ١٤٣-٢	Rehabilitation of sewer systems Structural outside buildings – Part ۲	بازسازی شبکه فاضلاب	انجمن آب آلمان	آلمانی
۱۲	DWA ١٤٣-٣	Rehabilitation of sewer systems outside buildings – Part ۳ Lining with cured-in-place pipes	بازسازی شبکه فاضلاب	انجمن آب آلمان	آلمانی
۱۳	DIN EN ٧٥٢	Drain and sewer systems outside buildings	بازسازی شبکه فاضلاب	استاندارد اروپا	انگیسی
۱۴	DIN EN ١٢٩٥ Part ١	Structural design of buried pipelines under various conditions of loading–general requitrements	بازسازی شبکه فاضلاب	استاندارد اروپا	آلمانی
۱۵	DIN EN ١٣٥٠٨ Part ٢	Investigation and assessment of drains and sewer systems outside buildings	بازسازی شبکه فاضلاب	استاندارد اروپا	–
۱۶	DIN EN ISO ١١٢٩٥	Classification and information on design and applications of plastics piping systems used for renovation and replacement	بازسازی شبکه فاضلاب	استاندارد اروپا	انگلیسی-آلمانی
۱۷	DIN EN ISO ١١٢٩٦ Part ١	Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks	بازسازی شبکه فاضلاب	استاندارد اروپا	آلمانی
۱۸	DIN EN ISO ١١٢٩٦ Part ٤	Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks networks Part ٤: Lining with cured-in-place pipes	بازسازی شبکه فاضلاب	استاندارد اروپا	انگیسی-آلمانی
۱۹	EN٤٧٦,ENV٧٣,EN١٢٩٣ ,EN ١٣٣٨٠ ,EN ١٤٤٥٧	General requirements for components etc.	بازسازی شبکه فاضلاب	استاندارد اروپا	–
۲۰	EN١٣٦٨٩	Guidance on the classification and design of plastics piping systems used for renovation	بازسازی شبکه فاضلاب	استاندارد اروپا	–
۲۱	DIN EN ١٥٨٨٥	Classification and characteristics of techniques for renovation, repair and replacement of drains and sewers	بازسازی شبکه فاضلاب	استاندارد اروپا	
۲۲	DWA-M ١٤٩-٥	Investigation and assessment of drains and sewer systems outside buildings	بازسازی شبکه فاضلاب	استاندارد آلمان	
۲۳	ATV ١٢٧	Structural design of buried pipelines	بازسازی شبکه فاضلاب	استاندارد آلمان	

Project Execution Cycle: From Cleaning to Verification

Understanding the Actual Network Condition

From Data to Asset Management
Inspect →Assess →Prioritize →Decide
- **Accurate Field Data**
- **Early Defect Detection**
- **Condition & Risk Assessment**
- **Maintenance & Rehabilitation Decisions**

Isfahan Sewer Network more than 4000km
Since the 1960s
No Data = Guesswork
Data = Asset Management

Sewer Cleaning: A Strategic, Not Merely Operational, Function

Cleaning →Inspection →Reliable Data →Sound Decisions

- **Preserve Hydraulic Capacity**
- **Remove Sediments, Grease & Obstructions**
- **Enable High-Quality CCTV Inspection**
- **Improve Defect Detection Accuracy**
- **Prepare the Network for Rehabilitation**

Technical Note:
Main Collectors ≤ 500 mm →Heavy-Duty Cleaning & Specialized Methods

Planning, Safety & Operational Control

Effective cleaning requires understanding line conditions, selecting appropriate operating parameters, and maintaining HSE controls.

- **Pre-Operation Assessment**

Sediment •Blockages •Connections •Hydraulic Conditions

- **Pressure & Flow Selection**

Based on pipe diameter, material & condition

- **HSE Compliance**

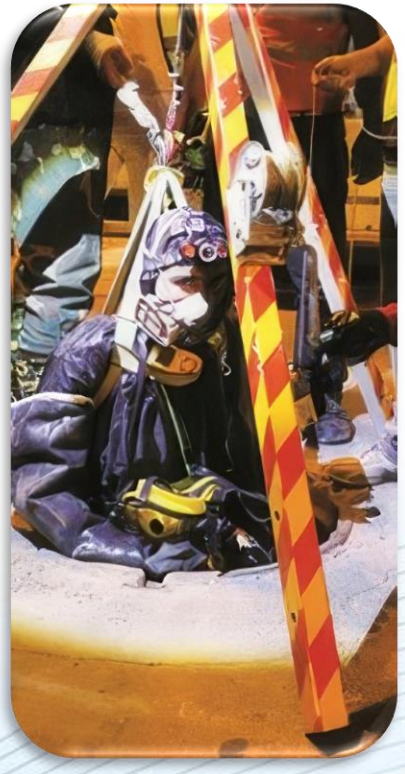
Confined Space •Gas Detection •PPE

- **Removed Material Management**

Collection •Disposal •Preventing Re-entry

- **Operation Documentation**

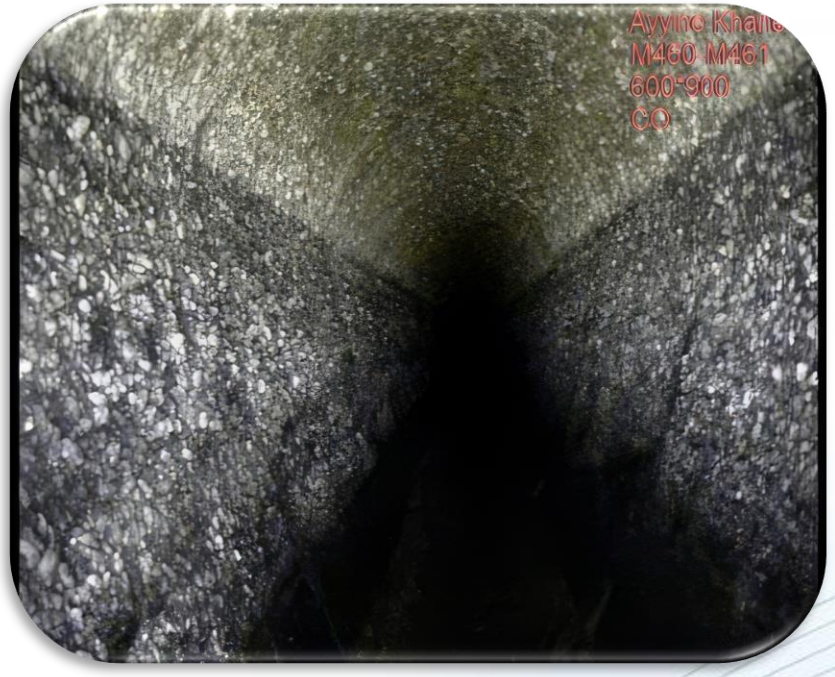
Route •Sediment Volume •Problems •Observed Conditions



Isfahan Project — Sewer Cleaning Experience

Restored Flow Capacity & CCTV Inspection Readiness

Up to ۷۰% Reduction in Cross-Sectional Blockage in Some Collectors



After Proper Cleaning & Sediment Removal

CCTV Inspection: Beyond Imaging

Turning Field Observations into Actionable Data for Assessment & Decision-Making

▪Defect & Anomaly Identification

Type •Location •Severity

▪Structural & Functional Condition Assessment

Basis for Maintenance & Rehabilitation Prioritization

▪Hidden Network Issues

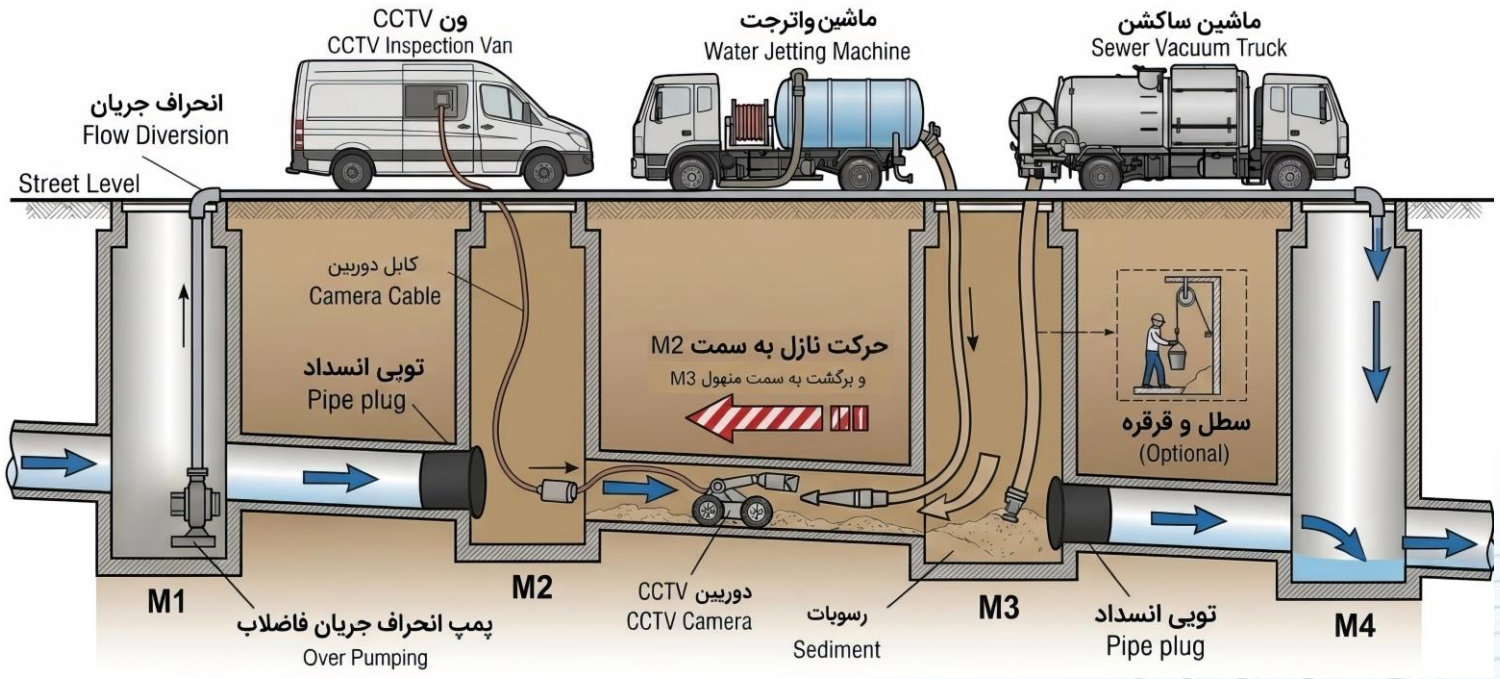
Groundwater Infiltration •Unauthorized Connections •Excavation-Related Damage

▪Construction & Rehabilitation Quality Control

Workmanship •Effectiveness of Interventions

Key Message

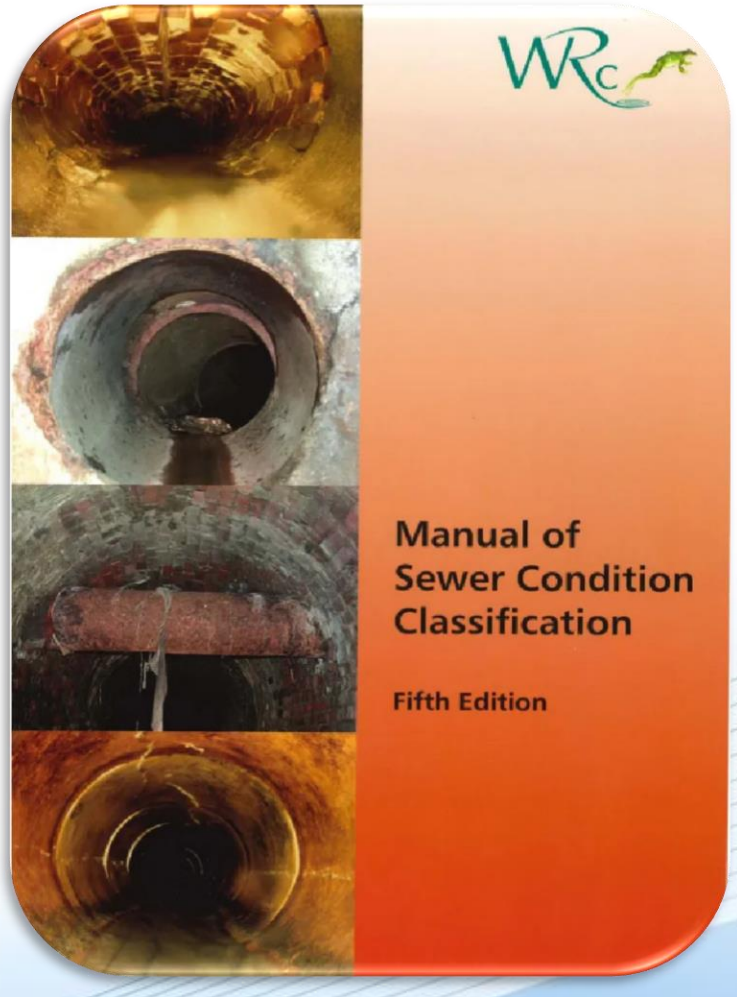
CCTV Output is Input Data for Coding & Condition Assessment —Not Just a Video Archive.



Data Quality & Structured Coding

Data Quality & Structured Coding
Transforming CCTV Images into Standardized, Analyzable Data for Decision-Making
▪Standardized Defect Coding
Isfahan Project: WRc –MSCC
▪Structured Defect Recording
Type •Location •Severity
▪Common Language for Network Condition Analysis
Consistent Assessment •Comparable Inspection Results
▪From Observations to Actionable Data
Assessment •Prioritization •Risk Management
▪Integration with Information & Asset Management Systems

Key Message
CCTV Without Structured Coding = Limited Decision-Making Data



From Inspection Data to Network Condition Grading

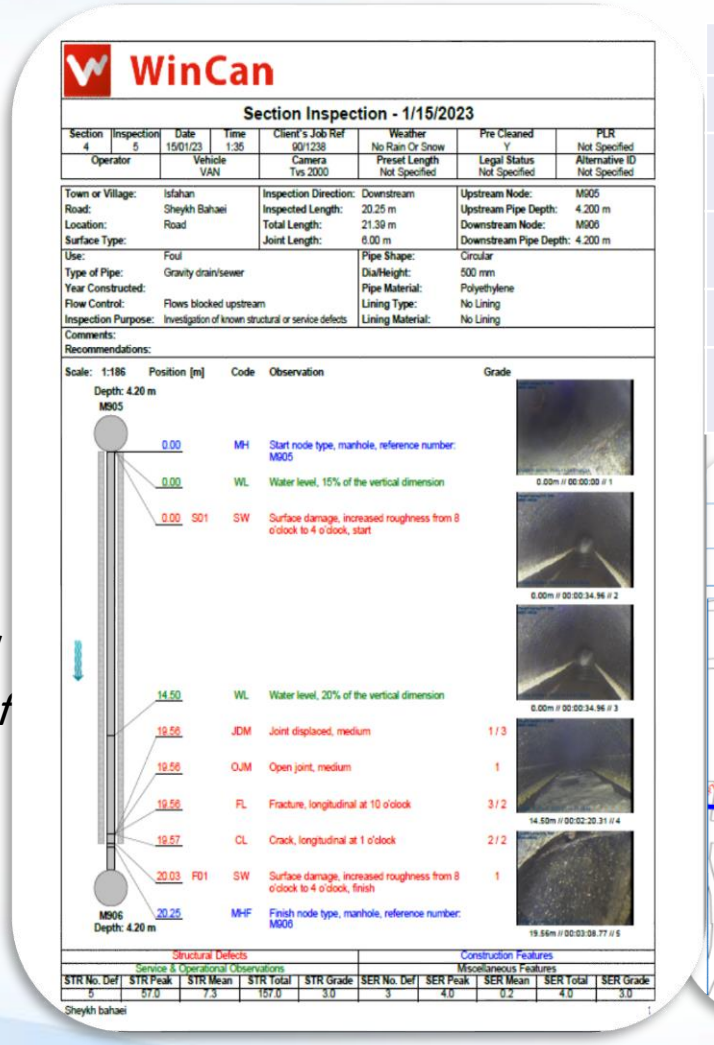
Inspection Data & Structured Coding

- **Record Pipe Segment & Defect Data in WinCan**
- **Georeferenced & Visual Defect Documentation**
- **Build an Analyzable Network Database**

ICG —Internal Condition Grade

An index for assessing the internal structural condition and severity of observed defects in sewer pipes.

ICG →From Defect Coding to Condition Grading


WinCan

Section Inspection - 1/15/2023

Section	Inspection	Date	Time	Client's Job Ref	Weather	Pre Cleaned	PLR
4	5	15/01/23	1:36	90/1238	No Rain Or Snow	Y	Not Specified
Operator		Vehicle		Camera	Preset Length	Legal Status	Alternative ID
		VAN		Tvs 2000	Not Specified	Not Specified	Not Specified

Town or Village:	Isfahan	Inspection Direction:	Downstream	Upstream Node:	M905
Road:	Sheykh Bahaei	Inspected Length:	20.25 m	Upstream Pipe Depth:	4.200 m
Location:	Road	Total Length:	21.39 m	Downstream Node:	M906
Surface Type:		Joint Length:	6.00 m	Downstream Pipe Depth:	4.200 m
Use:	Foul	Pipe Shape:	Circular		
Type of Pipe:	Gravity drain/sewer	Dia/Height:	500 mm		
Year Constructed:		Pipe Material:	Polyethylene		
Flow Control:	Flows blocked upstream	Lining Type:	No Lining		
Inspection Purpose:	Investigation of known structural or service defects	Lining Material:	No Lining		

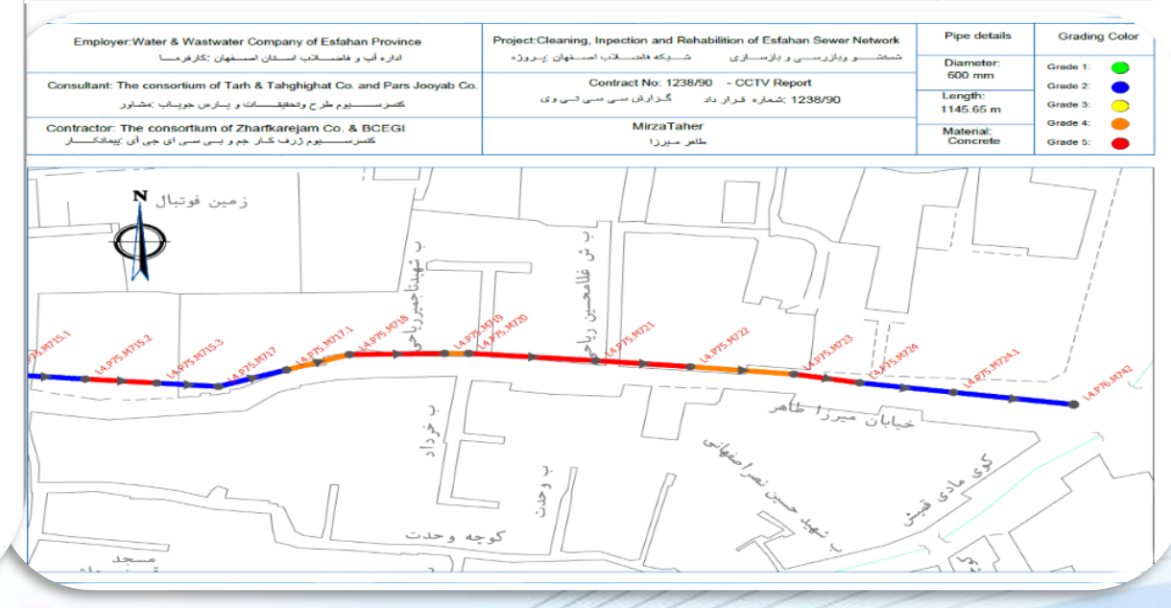
Comments:
Recommendations:

Scale: 1:186	Position [m]		Code	Observation	Grade
Depth: 4.20 m					
M905					
	0.00		MH	Start node type, manhole, reference number: M905	
	0.00		WL	Water level, 15% of the vertical dimension	
	0.00	S01	SW	Surface damage, increased roughness from 8 o'clock to 4 o'clock, start	
	14.50		WL	Water level, 20% of the vertical dimension	
	19.56		JDM	Joint displaced, medium	1 / 3
	19.56		OJM	Open joint, medium	1
	19.56		FL	Fracture, longitudinal at 10 o'clock	3 / 2
	19.57		CL	Crack, longitudinal at 1 o'clock	2 / 2
	20.03	F01	SW	Surface damage, increased roughness from 8 o'clock to 4 o'clock, finish	1
M906 Depth: 4.20 m	20.25		MHF	Finish node type, manhole, reference number: M906	

Structural Defects					Construction Features				
Service & Operational Observations					Miscellaneous Features				
STR No. Def	STR Peak	STR Mean	STR Total	STR Grade	SER No. Def	SER Peak	SER Mean	SER Total	SER Grade
5	57.0	7.3	157.0	3.0	3	4.0	0.2	4.0	3.0

Sheykh bahaei

Implication	Color	Grade
Acceptable structural condition		1
Minimal collapse likelihood in short term but potential for further deterioration		2
Collapse unlikely in near future but further deterioration likely		3
Collapsed or collapse imminent		4
Collapsed or collapse imminent		5



Thousands of Data Points & Images →One Meaningful Condition Assessment
ICG = Internal Condition Grade
A Quantifiable Indicator of Sewer Condition

Defect, Condition, Probability of Failure, Consequence & Risk

Physical Condition Alone Does Not Determine Rehabilitation Priority.

▪Defect

Localized physical observation: Crack •Fracture •Deformation •Leakage

▪Condition

Overall representation of defects and pipe-segment condition as a defined grade

▪Probability of Failure

Influenced by physical condition, age, material, environmental conditions & other factors

ICG —Internal Condition Grade

Initial grade derived from observed defects

SPG —Structural Performance Grade

Performance grade adjusted for factors influencing the probability of failure

▪Consequence of Failure

Influenced by pipe criticality, location & impact on the city and services

Sewer Criticality Classification (Criticality)

Criticality reflects the potential consequences and costs associated with sewer failure or rehabilitation.

▪Critical Sewers

Pipelines where failure or rehabilitation may result in **significant costs and consequences**

▪Key Criticality Criteria

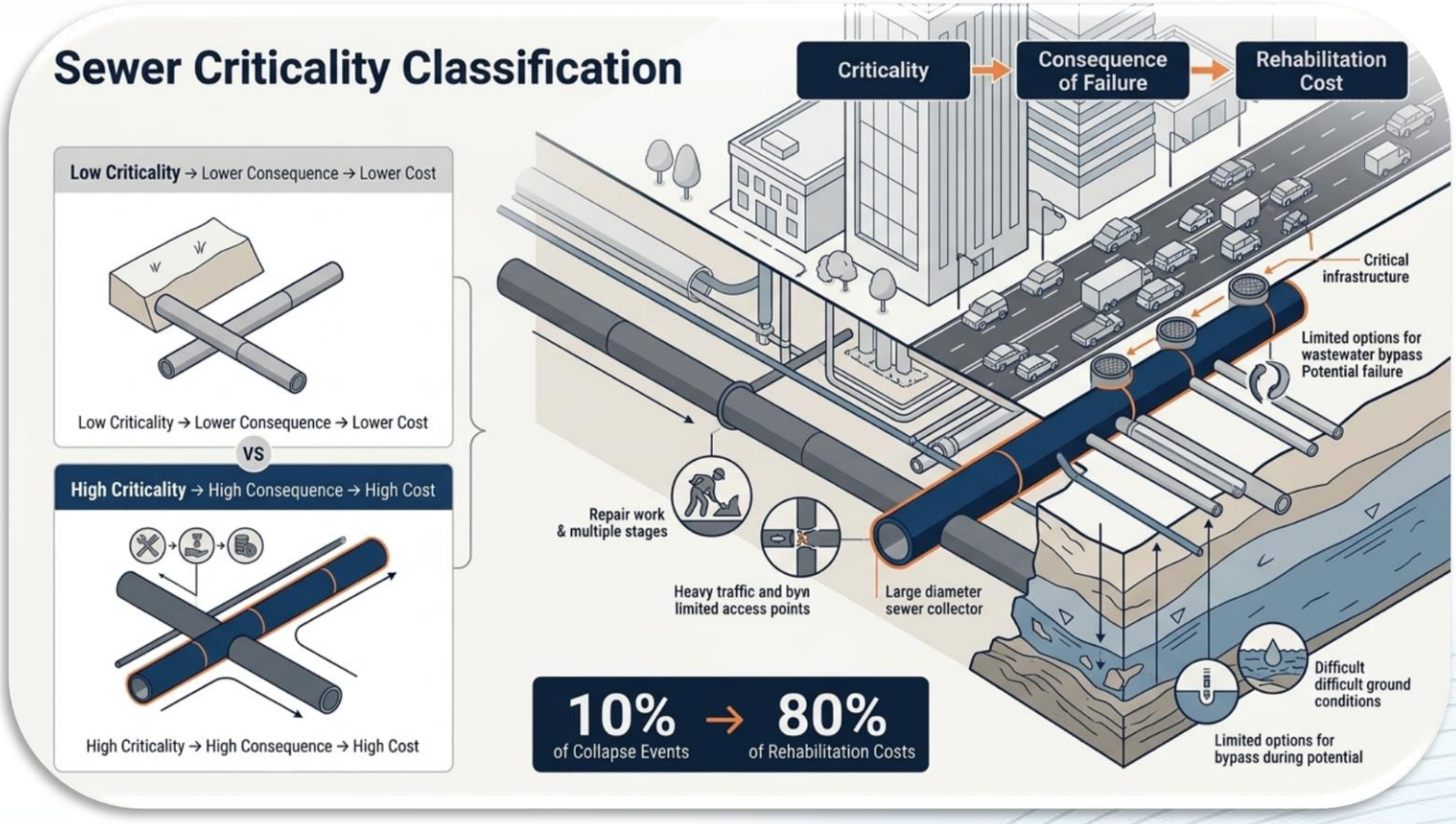
Deep burial •Weak soil / High groundwater •Large diameter •Proximity to buildings & critical utilities

▪Rehabilitation Constraints

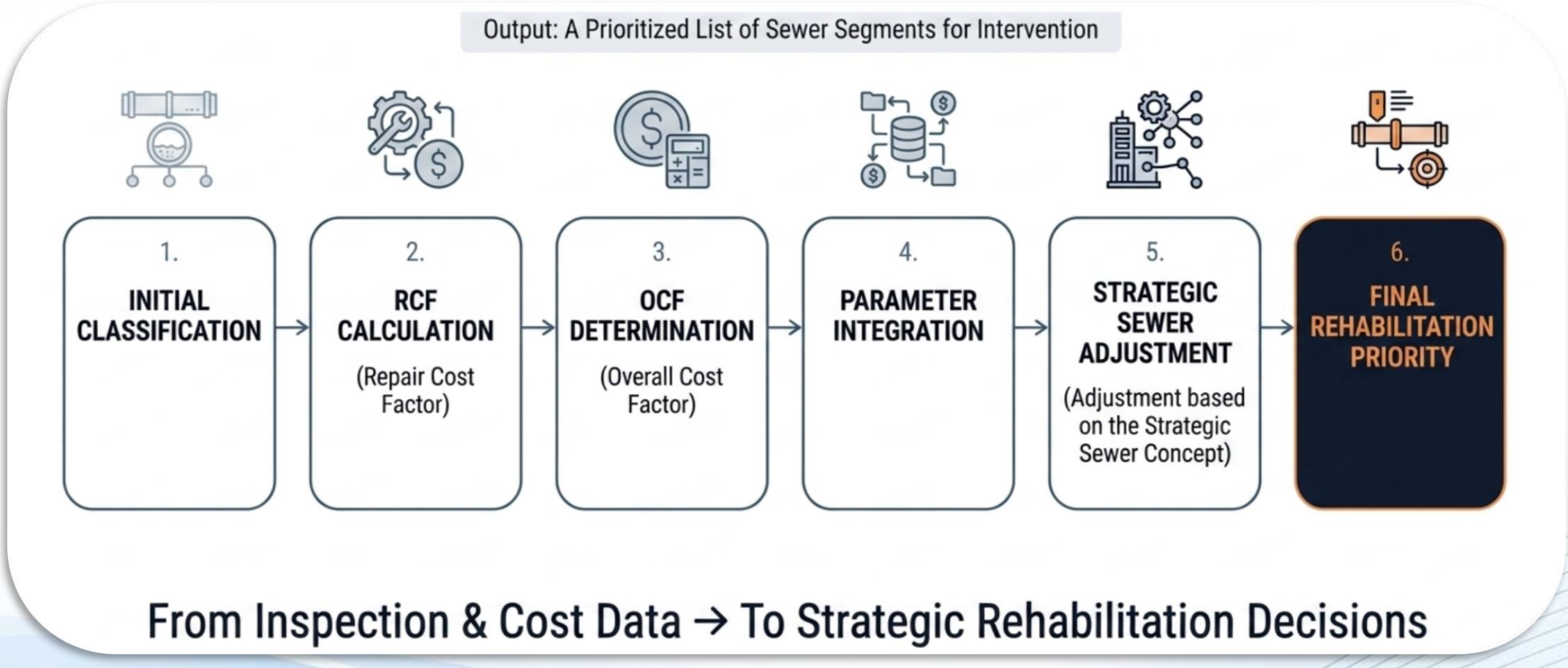
Traffic disruption •No Bypass option •Limited access •High execution cost

▪Special Network Conditions

Advanced age •Unreinforced concrete / No internal lining •High-traffic routes •Emergency access requirements.



Final Rehabilitation Prioritization Process



Risk Assessment & Prioritization — Isfahan Project

From Field Data & Influencing Factors →Network Risk Mapping & Prioritization

▪Risk Assessment

Based on **Guideline No. 677**

▪Project-Specific Inputs

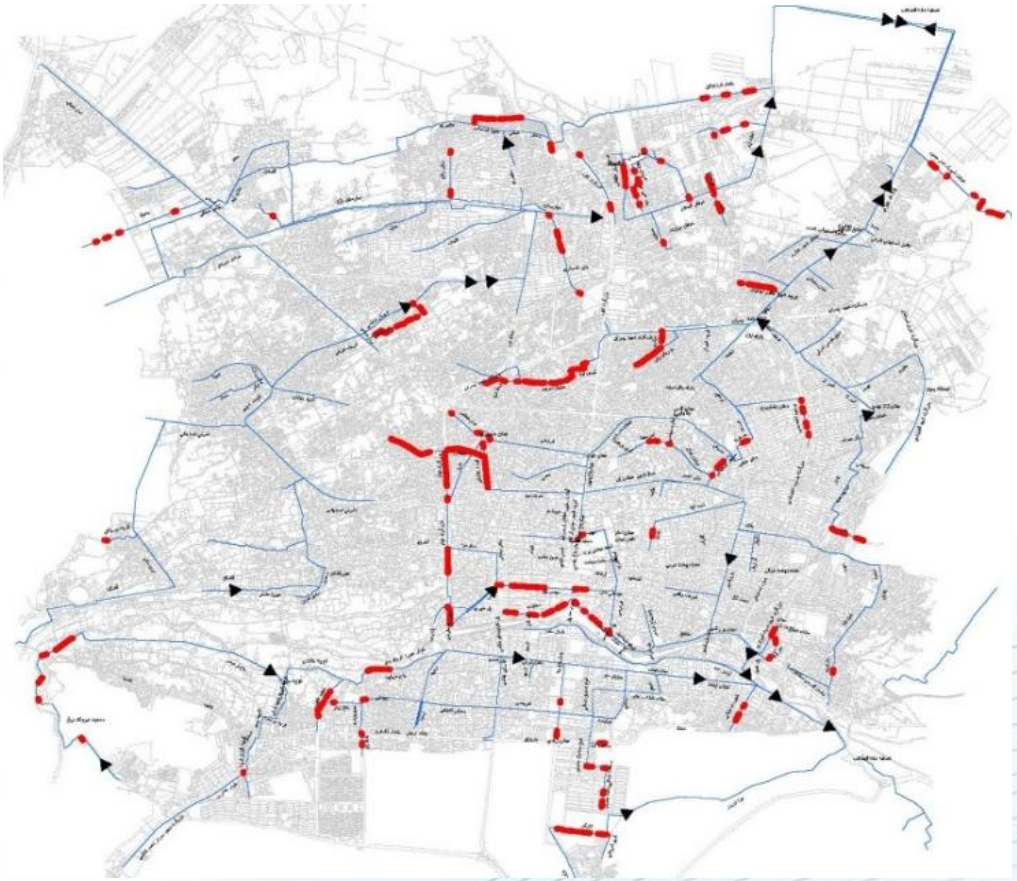
Soil Type •Traffic Load •Active Settlement •Groundwater Level • Collapse History •Cultural & Social Significance

▪Output

Citywide Risk Grading & Zonal Risk Mapping

▪Application

Translating risk assessment results into **Rehabilitation Planning & Prioritization**



Rehabilitation Method Selection Logic

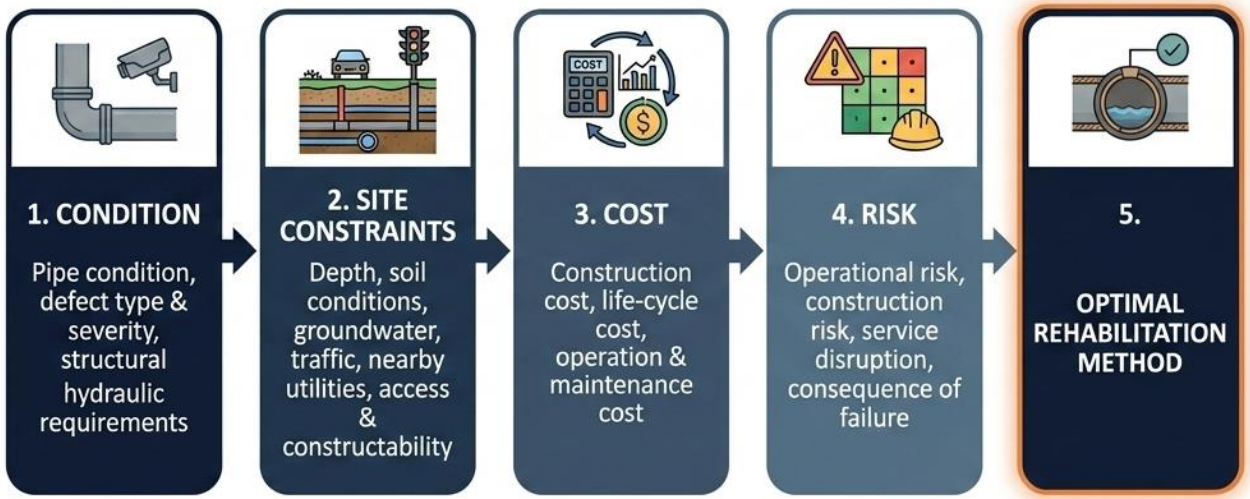
Rehabilitation method selection depends on the technical, constructability, and economic conditions of each pipe segment —not simply on cost or technology.

1-Technical Criteria
Pipe diameter and length, material, defect type and severity, structural condition, and required hydraulic capacity

2-Constructability Criteria
Burial depth, soil conditions, nearby utilities, traffic, access, and feasibility of excavation

3-Economic Criteria
Construction cost, **Life Cycle Cost (LCC)** & notiarepo dna , stsoc ecnanetniam

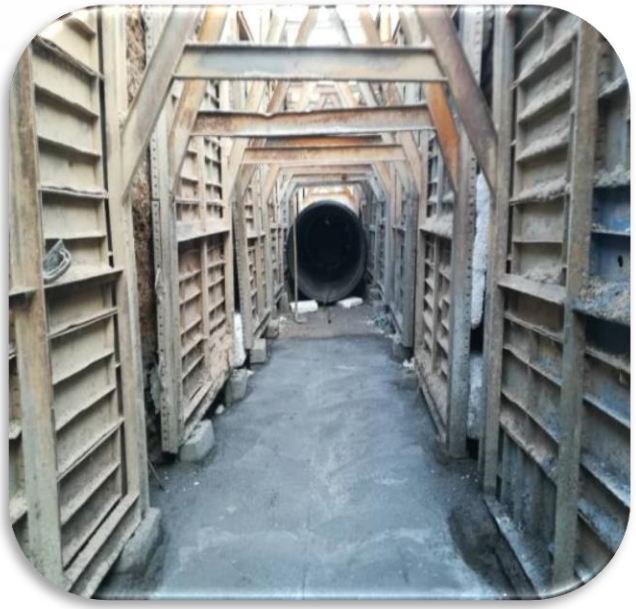
4-Operational & Risk Criteria
Execution duration, service continuity, construction risk, and operating conditions during rehabilitation



No Single Criterion Determines the Optimal Rehabilitation Method.

Brief Overview of Rehabilitation Methods

Rehabilitation Method	Suitable Application
Cured-In-Place Pipe (CIPP)	Structural rehabilitation of sewer pipes with moderate to severe damage, without excavation
Pipe Bursting	Full replacement of severely deteriorated pipes without open-trench excavation
Pipe Jacking	Installation of a new pipe using hydraulic jacking, suitable for deep alignments and crossing obstacles without open excavation
Open Cut Replacement	Full replacement where severe deterioration exists or trenchless methods are not feasible



Rehabilitation Execution & Quality Control

▪**Design Adaptation to Actual Pipe Conditions**

Liner/pipe design based on inspection data and the actual conditions of each pipe segment —not a standard or typical design

▪**Material & Site Condition Control**

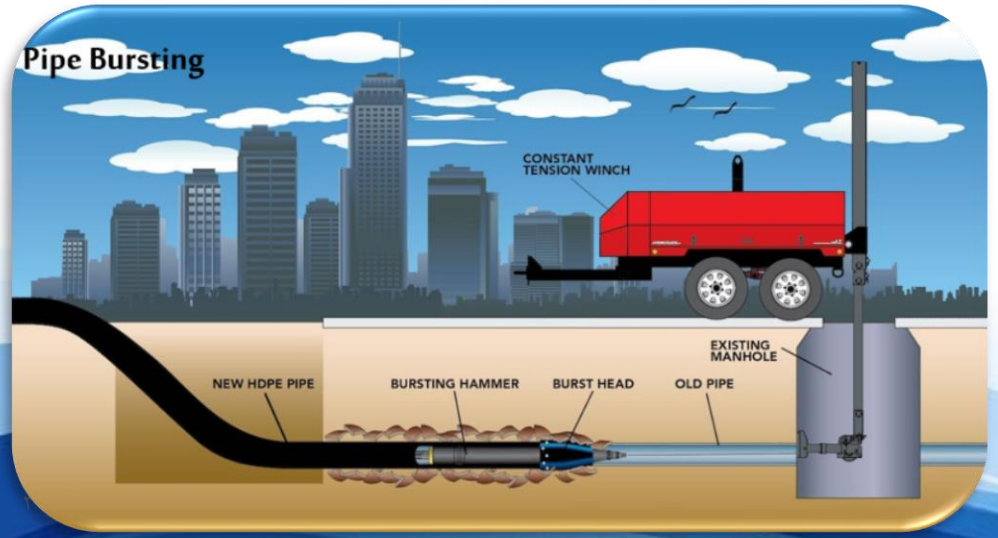
Quality control of materials, liner/pipe dimensions and specifications, and verification of site conditions prior to execution

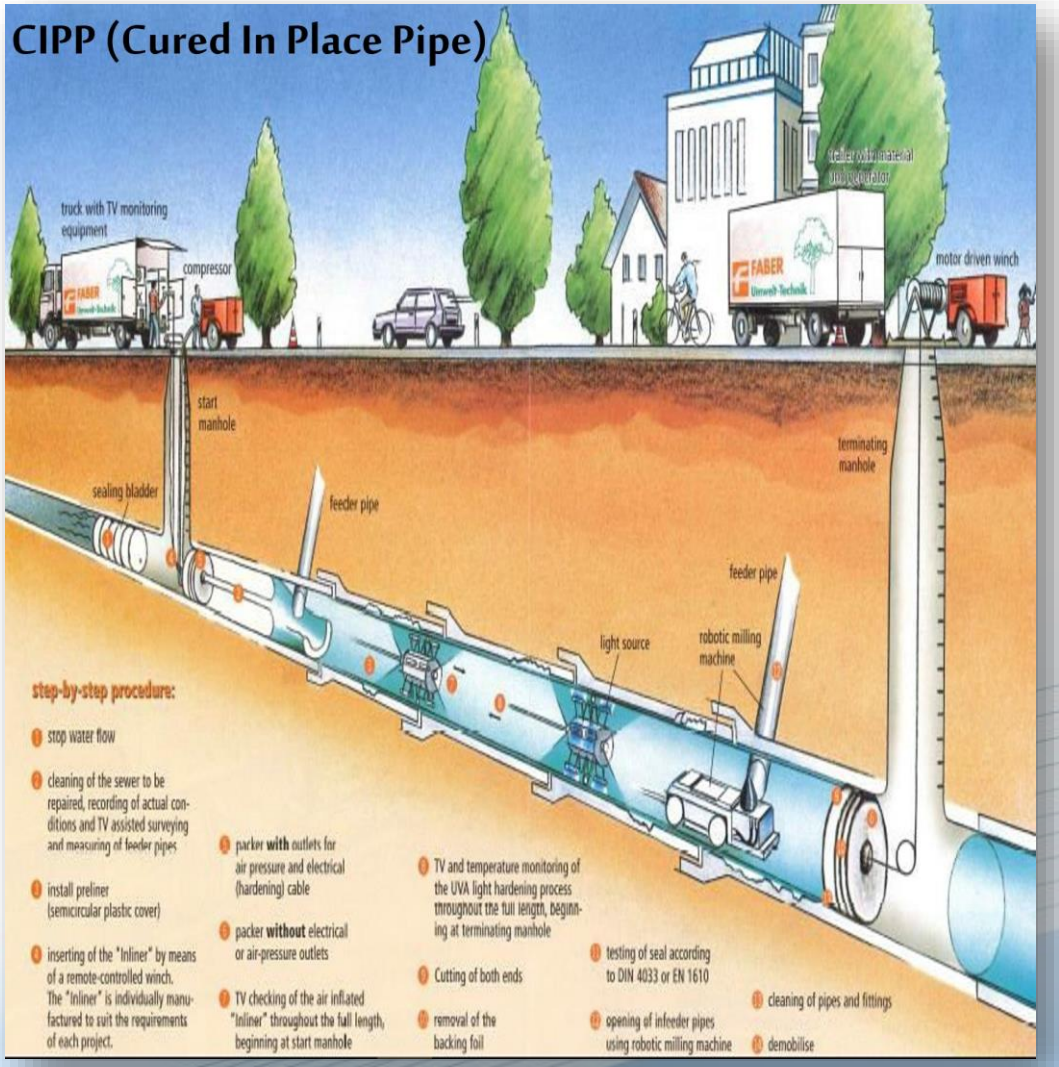
▪**Execution Quality Control**

Continuous supervision of the rehabilitation process, including required testing and quality control procedures

▪**Final Acceptance**

Post-rehabilitation CCTV inspection and verification of the completed work against design specifications and technical requirements





Isfahan Project — Execution & Quality Control

▪**Quality Control**

Inspection and quality control of pipes and materials by an **Independent Quality Inspector** fo notiacfiirev htiw , snotiacfiiceps lacinhcet htiw ecnailpmoc

▪**Final Acceptance**

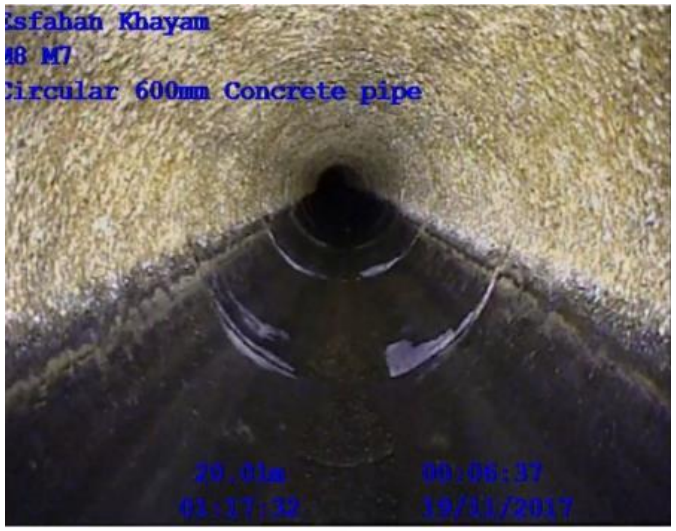
Post-installation **CCTV inspection** as the basis for quality control, acceptance, and verification of rehabilitation results

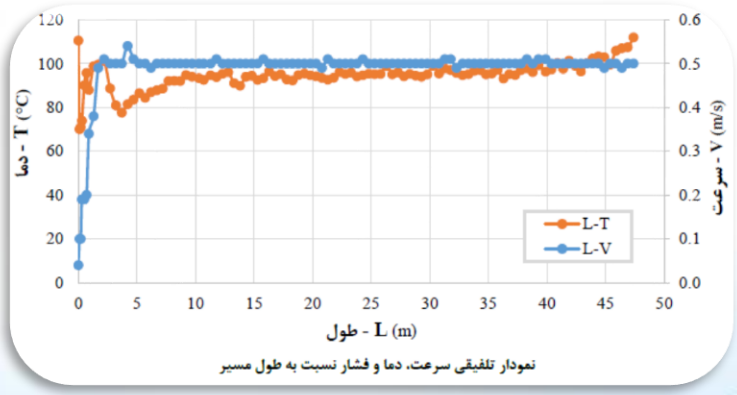
▪**Quality Control Testing**

Required testing of post-installation liner samples to verify material properties and compliance with technical specifications

▪**Curing Process Control**

Verification of curing uniformity based on the recorded data from the **CCU (Curing Control Unit)**





Isfahan Project — Sewer Manhole Rehabilitation

▪**Cleaning, Structural Assessment & Rehabilitation Method Selection**

Method selection tailored to the actual condition of each manhole

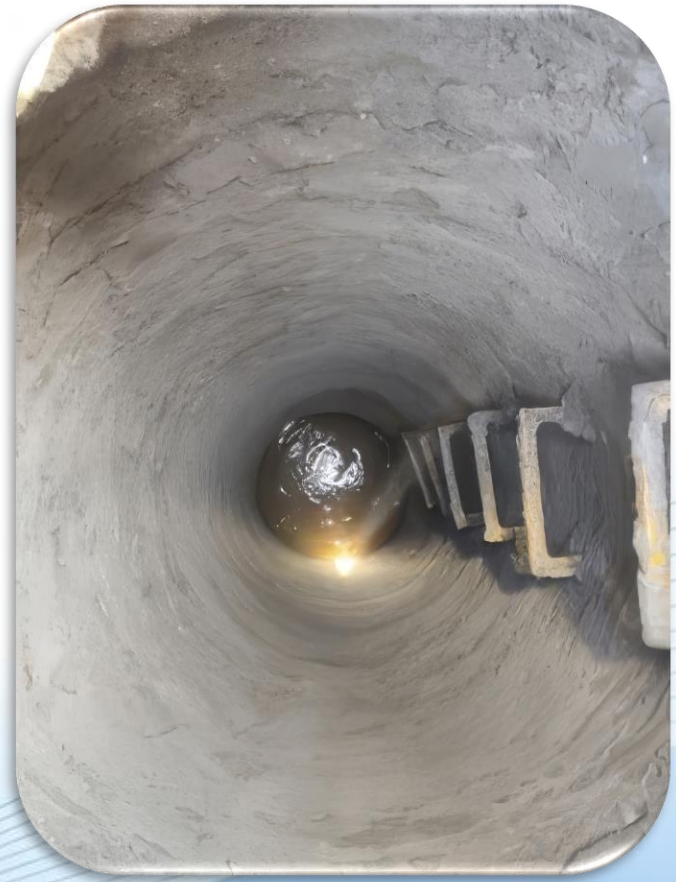
Key Activities:

▪Removal of **sediments and corrosive deposits**

▪Assessment of **corrosion, cracks, and damaged areas**

▪Selection of **materials and rehabilitation methods** based on the extent of damage

▪Rehabilitation using **repair mortars and centrifugal Spray Coating**



Technical & Practical Experience; From Field Data to Strategic Decision-Making (1)

- **Data quality starts from the very first step**

Proper cleaning and pipe preparation are prerequisites for reliable inspection.

- **Data quality matters more than data volume**

Incomplete or unreliable data can lead to incorrect decisions.

- **CCTV creates decision value only when supported by structured analysis and coding.**
- **Physical condition alone is not sufficient for prioritization**

The consequence and criticality of the sewer must also be considered.

- **Rehabilitation decisions should be risk-based — not based solely on structural condition grade.**

Technical & Practical Experience; From Field Data to Strategic Decision-Making (2)

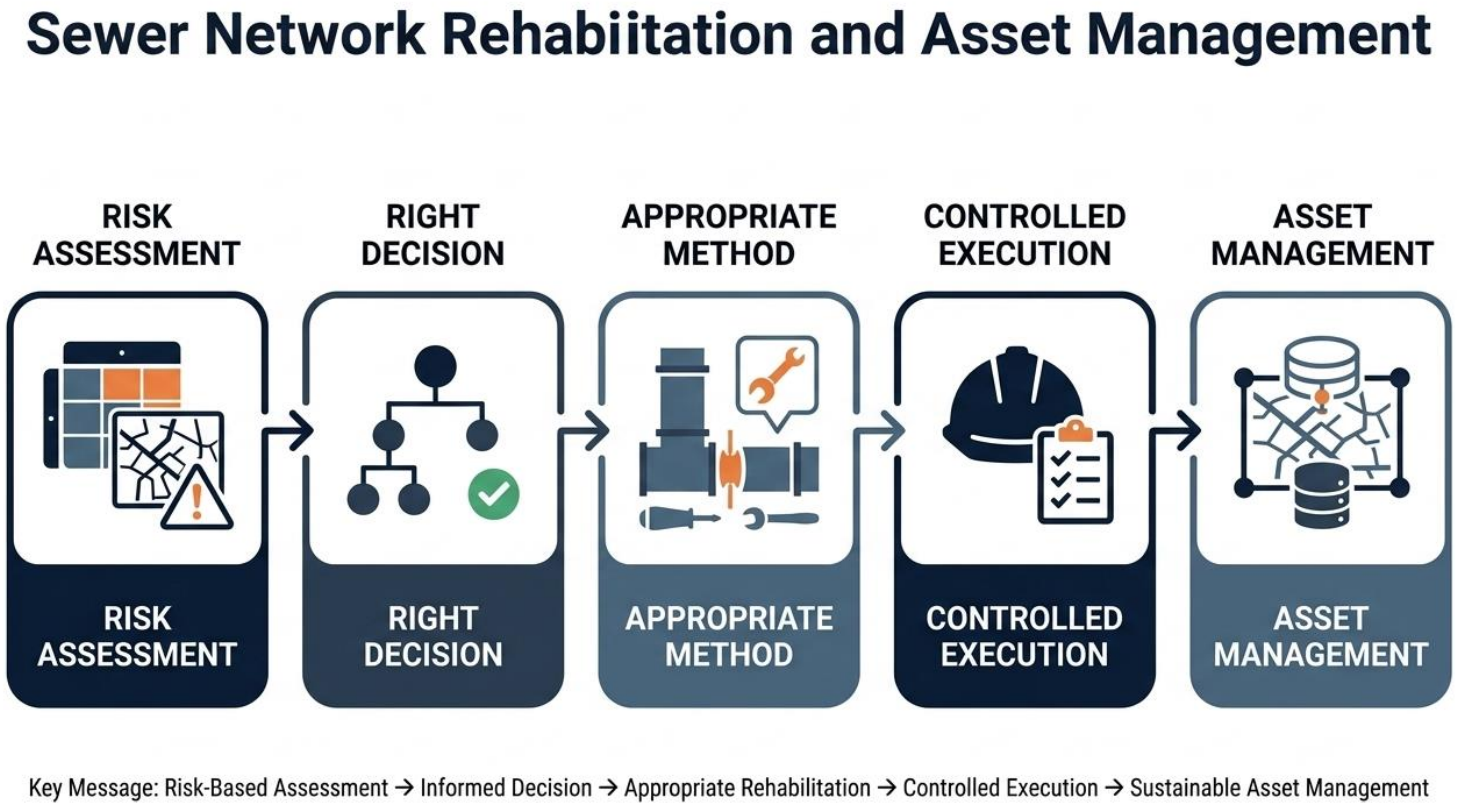
▪**Rehabilitation method selection should be project-specific**
Not driven by a fixed technology or predetermined preference.

▪**Design and execution must be closely integrated**
Standardized designs without adaptation to field data can increase execution risk.

▪**Clear roles and responsibilities are essential**
Clearly defined responsibilities across design, execution, supervision, and quality control reduce project risk.

▪**Field data creates value only when translated into management decisions**
Data is not an end in itself.

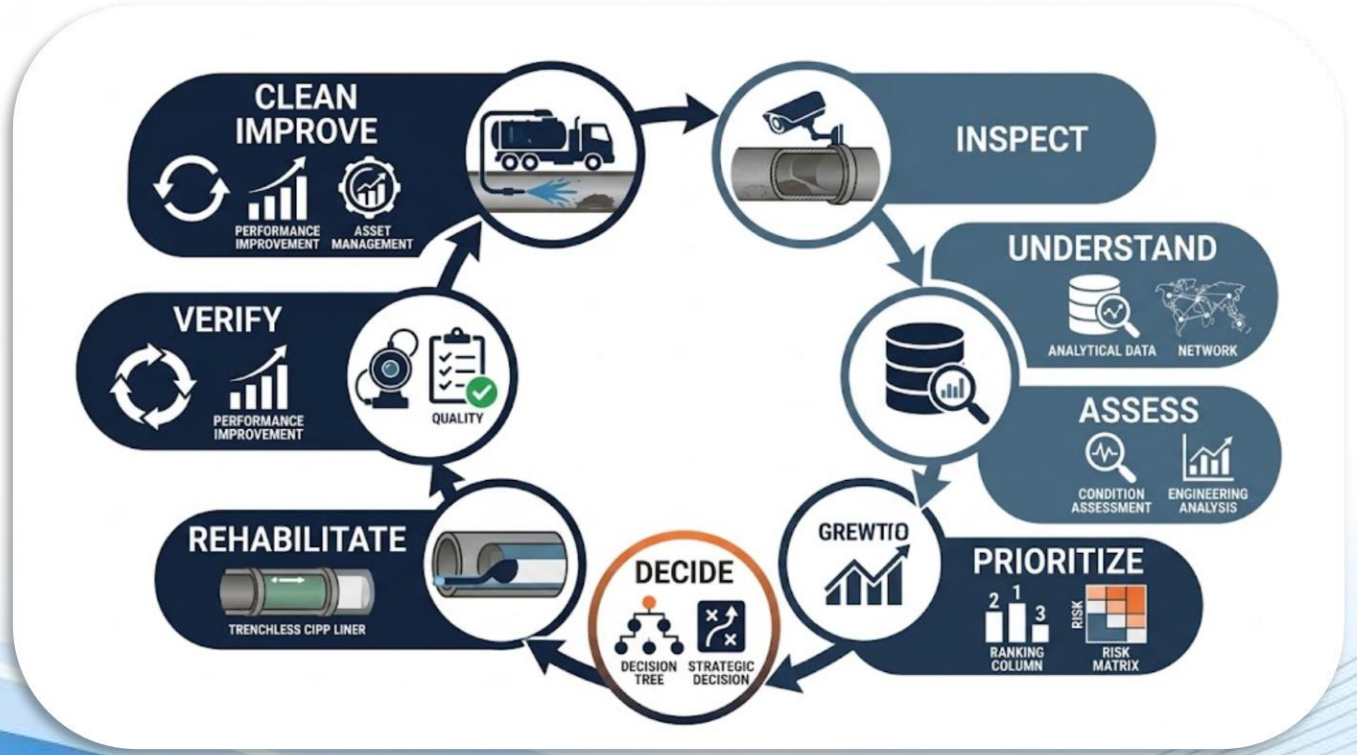
▪**Asset management is not possible without a true understanding of asset condition.**



The goal is not to rehabilitate a single pipe; it is to transform real-world data into the right decisions for effective asset management.

From Inspection to Rehabilitation; A Risk-Based Decision-Making Cycle

Successful sewer rehabilitation does not begin with rehabilitation works;
it begins with a true understanding of the asset, reliable field data, condition assessment, and risk-based decision-making.



Experience shows that rehabilitation success depends less on selecting a specific technology and more on the quality of .understanding, decision-making, and process control

شرکت آب و فاضلاب استان اصفهان

Water & Waste Water Company of Isfahan Province

مهندسین مشاور طرح و تحقیقات آب و فاضلاب

Tarh va Tahghighat Ab va Fazelab

(Water & Wastewater Consulting Engineers)

Thank You for Your Attention