TRANS ADRIATIC PIPELINE PROJECT
OFFSHORE PIPELINE DETAIL DESIGN

Rev.	Date	Description	Prepared	Checked	Approved
00	28.01.2016	Issued for Construction	SpagnaMusso	Onori	Badalini
0B	18.09.2015	Re-issued for Review	SpagnaMusso	Marchionni	Badalini
0A	11.09.2015	Issued for Review	SpagnaMusso	Marchionni	Badalini
A	07.09.2015	Issued for IDC	SpagnaMusso	Marchionni	Badalini

Statoil

Trans Adriatic Pipeline

Construction Site at Italian Landfall
Design of the new access road

Originator Job 022720	Doc. **01-LA-E-80023**	Contract: 4502485266 CTR H06.01	LCI ☑ Yes ☐ No

SAIPEM

Document Number

OPL00	SPF	122	Q	TRX	0004	00
Project No.	Orig. Code	System/area	Disc. Code	Cod. Type	Seq. No.	Rev.

CONTENTS

1 INTRODUCTION

1.1 TAP Project Summary

The Trans Adriatic Pipeline (TAP) is a proposed pipeline in the Southern Gas Corridor that will bring gas from new sources in the Caspian region to Western and South Eastern Europe. The 871 km pipeline will connect to existing gas networks and start in Greece, cross Albania and the Adriatic Sea and come ashore in southern Italy, allowing gas to flow directly from the Caspian basin into European markets.

The Trans Adriatic Pipeline is divided into two parts, where Statoil ASA is technical service provider for TAP AG (TSP West), and E.on Ruhrgas is technical service provider for TAP AG (TSP East).

The responsibilities are:

- TSP East will be responsible for the onshore pipeline, onshore fibre optic cable and all facilities in Albania, Greece and Italy;
- TSP West will be responsible for the offshore pipeline, offshore fibre optic cable and the landfalls in both Albania and Italy.

1.2 TSP WEST Pipeline Description

The pipeline system covers the offshore pipeline across the Adriatic Sea from the first dry weld on the Albanian side to Italy's southern Puglia region for further transport to Western Europe. The TSP West pipeline system consists of an approximately 105 km long offshore pipeline, with landfalls in both Albania and Italy.

The Italian pipeline landfall will be on the coast between San Foca and Torre Specchia Ruggeri in the municipality of Melendugno, while the Albanian landfall area is located North-West of Fier.

The project will also contain a FOC installed parallel with the pipeline to enable communication between the TAP terminal, the pressure stations in Albania and Greece as well as the block valve stations installed along the 871 km long pipeline.

2 SCOPE OF DOCUMENT

This document is part of the design framework for the temporary roads to access the Microtunnel construction site at the Italian landfall (San Foca).
In particular, it deals with the design for the new access road to be built for the completion of the transport system.
The new access road shall be connected to the main existing municipal road S. Niceta.
A site visit has been carried out on 18/08/2015 in order to select a suitable access route; the relevant main findings are included in the present report.
This document also describes the main construction process which is to result in optimum construction, taking into consideration preliminary HSE and environmental aspects, deadlines, costs, quality and technical feasibility. During the course of the project, the level of detail has to be continuously adjusted as soon as the more detailed contract award modalities and relevant concepts of the Contractor are known.

3 SUMMARY AND CONCLUSIONS

The section of "new" access road has been conventionally identified between the point C, located in correspondence of the T junction between the existing road S.Niceta (to be improved to be suitable for the project transport requirements) and the road to Masseria S. Basilio, and the tie-in point located inside the Landfall construction yard

The length of this section is 489 m.

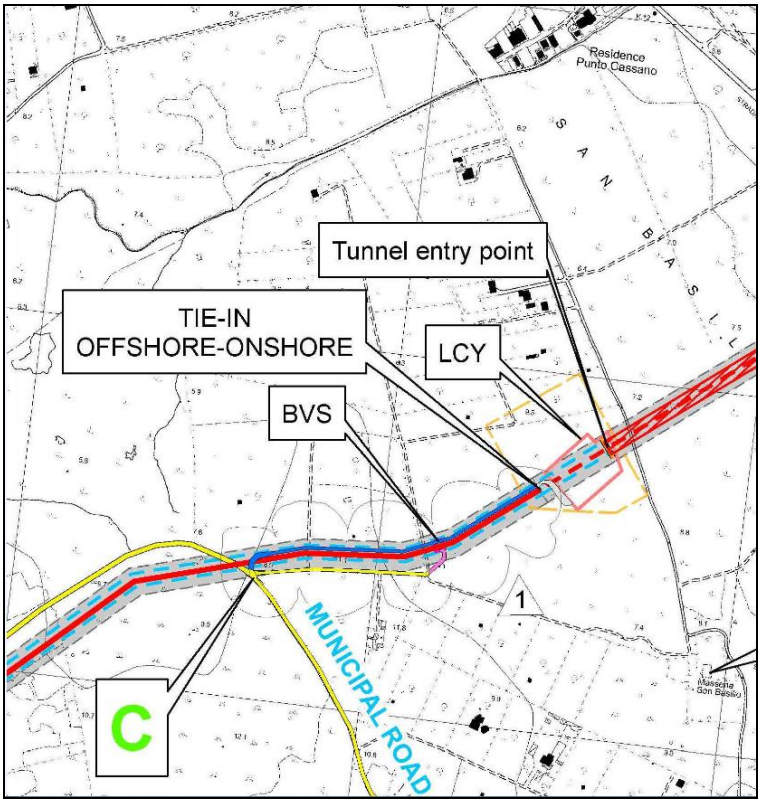


Fig. 3.1 –New Access Road within "future" pipeline ROW.

For the majority of its length, the access road is designed inside of the RoW that is already approved for the future TAP pipeline.

The access road, shall be a road embankment type without removing the topsoil.
For the new section of the access road to be built, a minimum width of 4 m is considered, with a 25 cm of grain mix as “road body”. A small ditch aside the carriageway shall be foreseen for the rainwater drainage (see Fig. 8.1).

In order to ensure the separation between the embankment and the natural ground surface (topsoil), a sheet of geotextile will be laid on the entire footprint of the road.

The road works to be carried out for the temporary access road (new section) are summarized in the following preliminary bill of main quantities:

Item	*Unit*	*Q.ty*
Olive trees removal	Nr	41
Subgrade compaction in soil	m^2	2000
Geotextile	m^2	2500
Granular mix (after compaction)	m^3	710
Finishing Compaction	m^2	2000

4 RECOMMENDATIONS

It is recommended to pay particular attention to the curve at T junction with municipal road S. Niceta, considering the necessity to guarantee a safe transit and a feasible manoeuvrability of the trailers in the curve.

5 DEFINITION, ABBREVIATIONS AND UNITS OF MEASUREMENTS

5.1 Definition

- Company — TAP AG
- Contractor — Access Road Construction Contractor
- Laying Contractor — Service provider for pipeline laying operation
- Site Preparation Contractor — Service provider for civil works and site preparation operation
- Project — TRANS ADRIATIC PIPELINE PROJECT
- Work — All work and services to be performed by contractor to satisfy all of Contractor's obligations under the CONTRACT
- Subgrade — Original topsoil strip in-situ under the road embankment
- Embankment — Road body material

5.2 Abbreviations

- FOC — Fiber Optic Cable
- EOD — Explosive Ordinance Disposal
- TSP — Technical Service Provider
- TAP — Trans Adriatic Pipeline
- LCY — Landfall Construction Yard
- MTBM — Microtunnel Boring Machine

5.3 Units of measurements

International System (SI) units shall be used.

6 REFERENCE DOCUMENTS

The reference documentation has been grouped as follows:

- Project Documents
- Design Codes and Standards

Unless specifically indicated, latest revision to be applied.

6.1 Project Documents

1.	OPL00-SPF-122-Q-TSP-0001_02	Access Road to Construction Yard Construction Specification
2.	OPL00-SPF-122-Q-DQR-0003_02	Access Road Network to Construction Yard - Overall Map
3.	OPL00-SPF-122-Q-DQR-0004_02	Access Road Network to Construction Yard – Layout
4.	OPL00-SPF-122-Q-DQR-0005_02	Access Road to Construction Yard - Typical Cross section
5.	OPL00-SPF-124-Q-DGD-0002_01	Working area lay-out at tunnel starting point
6.	IPL00-SPF-100-F-DFT-0014_01	Typical for the Access Road
7.	OPL00-SPF-122-Q-TRX-0001_00	Italian Landfall Access Road to Construction Yard Feasibility study
8.	OPL00-SPF-122-DRQ-0008_0A	Plan, Profile and BoQ for new Access road
9.	OPL00-SPF-122-TRX-0003_0A	Italian Landfall – existing access road for LCY – Technical report

6.2 Design Codes and Standards

10.	Decreto Ministeriale 19/04/2006	Ministero delle Infrastrutture e dei Trasporti Norme funzionali e geometriche per la costruzione delle intersezioni stradali (Gazzetta ufficiale 24/07/2006 n. 170).
11.	ISO 15688:2012	Road construction and maintenance equipment -- Soil stabilizers Terminology and commercial specifications
12.	EN 13036 Part 1, 3, 4 and 7.	Road and airfield surface characteristics – Test methods
13.	EN 13249	Geotextiles and geotextile-related product – Characteristics required for use in the construction of roads and other traffic areas
14.	ASTM D1241	Standard Specification for Materials for Soil-Aggregate Sub-base, Base, and Surface Courses.
15.	ASTM D1242	Standard Test Methods for Resistance of Plastic Materials to Abrasion
16.	AASHTO	Design guide 3rd edition 2006
17.	ASTM C117 - 13	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
18.	ASTM C136,	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
19.	ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine,
20.	ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
21.	ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil
22.	ASTM D422	Standard Test Method for Particle-Size Analysis of Soils

23. DM 5 novembre 2001, n. 6792 — (S.O. n.5 alla G.U. n.3. del 4.1.02) Norme funzionali e geometriche per la costruzione delle strade AASHTO Design guide 3rd edition 2006

24. UNI 10006: 2002, — Costruzione e manutenzione delle strade - tecniche di impiego delle terre (Road Construction and Maintenance, (technical provision for use of soil)

25. EN 1991. 02 — Traffic Loads on Bridges

7 LOCATION AREA

The area affected by the new access road is located between the San Niceta Municipal road, that shall be improved for the construction purpose as per ref. 9, and the area of Masseria San Basilio in vicinity of which the construction area of the microtunnel is planned. The road passes through an olive tree grove taking advantage of the working strip of 18 m already acquired for the onshore pipeline RoW (Fig. 7.1).
The landscape of the area is formed by a slightly undulated plain.

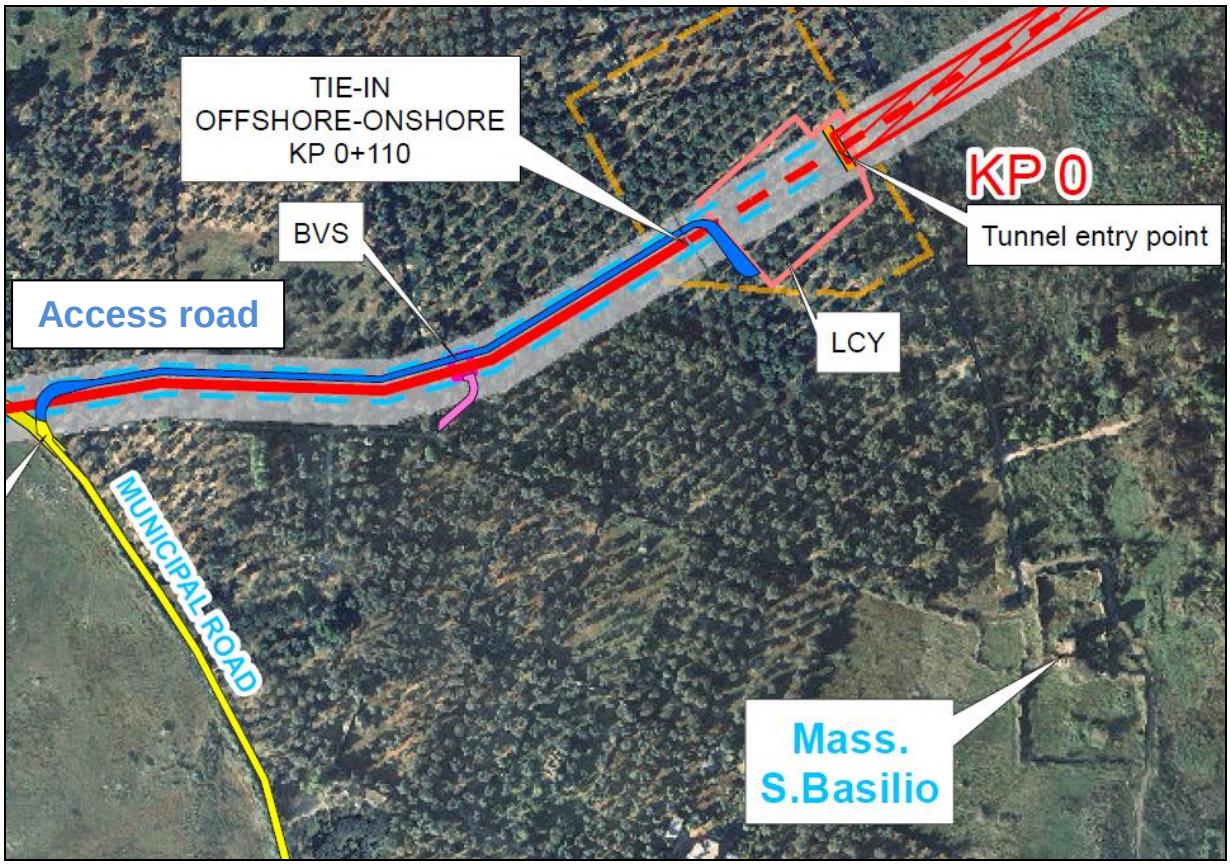


Fig. 7.1 – New Access Road Location.

7.1 Geological and Geotechnical investigation

From a geological point of view, the site area belongs entirely to the "Calcarenite del Salento" formation. With reference to the stratigraphic logs of executed boreholes (see Fig.7.2), the deposit is composed mainly by yellow to whitish sand (about 65%), with minor layers of silty sand (15%) and rare layers of gravel – coarse sand (5%). Laboratory tests about particle size distribution indicate that the sandy fraction ranges from 50% to 85%; the dry unit weight is comprised in the range 16-18 kN/m^3.
Interbedded with sandy sediments there are calcarenitic layers (15%), normally of sub-metric thickness, often very fractured.
No other correlations can be assumed from geological data; therefore at the scale of the site the sand sequence may be considered roughly homogeneous in the investigated depth.

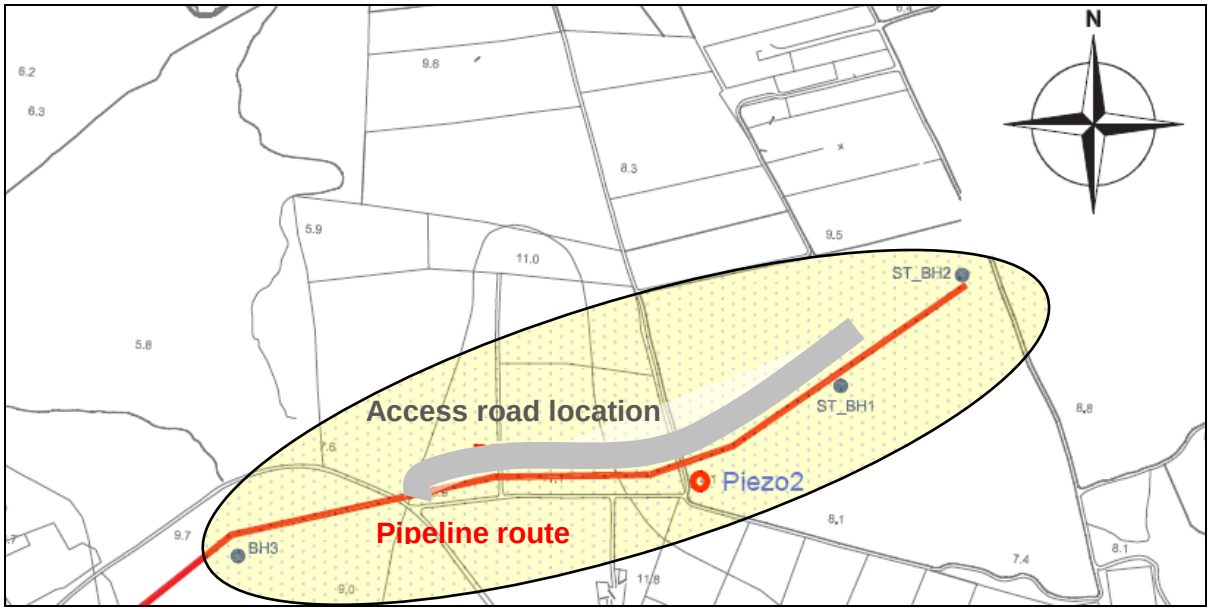


Fig. 7.2 – Location of geotechnical investigation.

8 CRITERIA FOR ACCESS ROAD TO LANDFALL CONSTRUCTION YARD

8.1 General

A temporary access road to TAP Landfall Construction Yard (LCY) will be constructed to allow the passage of construction equipment, lorries, fire-fighting and emergency vehicles requested for the execution of microtunnel and pipeline installation within TSPW project.

The following criteria are the basis of this study:

- The access road shall be built with granular material specified in § 8.4.3, without topsoil removal
- The whole access road shall be developed within the designed ROW already established for the onshore pipeline considering the use of strip of land already included in permits acquisition process (e.g. single authorization).
- The carriageway width shall be 4 m with batter slope ratio of 1:2
- Particular attention has been paid to the space necessary in the turning points at the connection to the existing roads, in relation to the type of load to be handled and transported.
- During the working period the roads shall be always maintained in a good and suitable condition.

The works planned for new access road shall be designed to withstand loads of Load Model 1 defined in EN 1991.02, §4.3.2. (see ref. 25)

The necessary authority's application permits, relevant to the use of existing roads as temporary access to the LCY, will be managed by Company; Contractor shall support and assist Company for any design detail requested for the purpose.

8.2 Construction steps

The overall construction of the access road will consist of:

- Olive trees removal;
- Clearing and grubbing the existing vegetation;
- Subgrade preparation (without topsoil stripping);
- Importing, placing and compacting of road embankment material;
- Road catch drains.

Typical cross section of access road is shown in Fig 8.1.

Access road will be constructed to allow the passage of construction equipment, materials and manpower.

A minimum width of 4 m is considered.

Activities shall be conducted in such a manner as to minimise disturbance to watercourses, drainage and dyke structures.
During the working period the roads shall be maintained in a good and suitable condition.

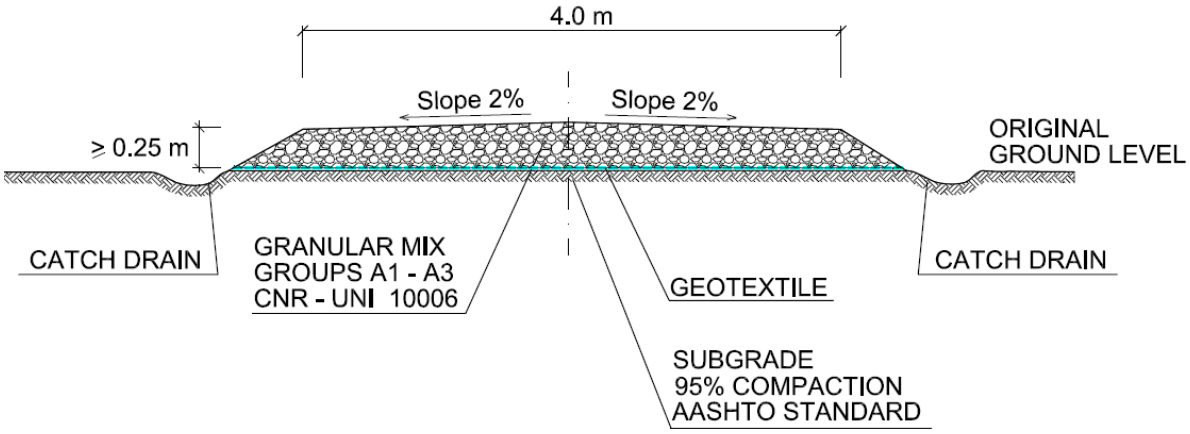


Fig. 8.1 - Typical cross sections for proposed Access Road

8.3 Access Road completion

The access road is considered a temporary work, which is being developed within the future working strip for TAP onshore pipeline construction.
For this reason, Contractor in charge for the new access road construction will not be required to carry out any restoration work or reinstatement of the previous environmental conditions; the construction of the pipeline will acquire the strip used by the access road within its Right of Way (RoW) as shown in Fig. 9.1. The final restoration of the site, including the new access road strip routed inside the pipeline Right of Way, shall be within the onshore pipeline Contractor SOW.

8.4 Transport requirement

The following section defines the expected transport requirement that have been already analysed in the feasibility report (ref. 7).

The main and heavier material to be transported along the access road is listed here below:

- Concrete line pipes for Microtunnel (Fig. 8.4)

Moreover other important loads to be transported are as follows:

- Microtunnel boring Machine (MTBM)
- Gantry crane and/or other lifting equipment for Microtunnel construction
- Linear winch for pipeline installation (Fig. 8.7)
- Temporary pig trap for offshore Hydrotest.

Concrete line pipes and most of the tunneling equipment will be transported by standard trailers (trailer length 13m, width < 2,5m, weight < 24 ton).

Only a few components will need special transport:

- Low bed trailer to transport the control cabin and separator unit
- Heavy load lorry to transport the MTBM jacking machine

The worksite entrance road will be designed for those truck dimensions.
In addition, the possibility of local load concentration shall be taken into account due to the location of mobile cranes (100 tons) on the roads for the unloading and installation of the components.

Fig. 8.2 – Microtunnel construction yard

8.4.1 Concrete lining pipes for Microtunnel

Transport of the concrete jacking pipes for microtunnel has been find out as the most challenging item for access road definition, in consideration of the number of elements to be moved to the site and their weight and dimension.

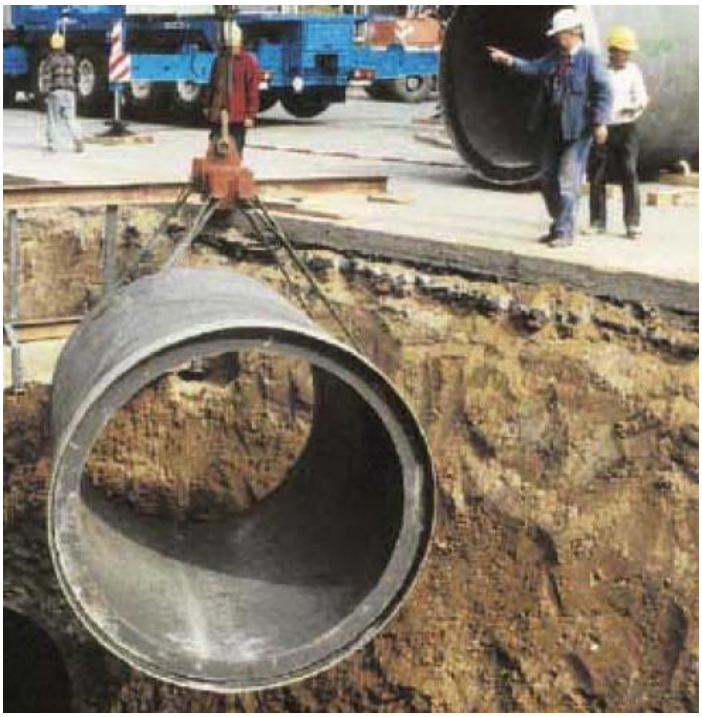


Fig. 8.3 – Reinforced concrete jacking pipe

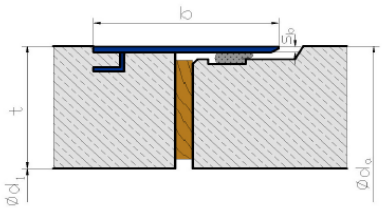
The expected dimension of the RC jacking pipe is as follows:

Jacking pipes from DN 300 to DN 3200

according DIN EN 1916 and DIN V 1201

Measurements

Pipe type	Typ 2 according DIN V 1201
Pipe joint	spigot end, chamber sealing
Material	concrete C 40/50 acc. EN 206-1 and DIN 1045-2
Laying help	implemented anchor
Capacity	on request



DN	External diameter		wall thickness	length *1	pressing force	Guid ring *2
2400	3000	3006	300	3.00 + 3.30	19400	250*10

The TAP landfall microtunnel foresees a continuous installation of concrete pipes for a length of about 1500 m, hence, considering 3 m length for the single RC pipe, almost 500 jacking pipes has to be transported and stacked in the construction yard.

Fig. 8.4 – Transport and stacking of concrete pipes

The weight of each RC pipe shall be approx. 20 ton; the dimension for truck transport is indicatively shown in Fig. 8.5.

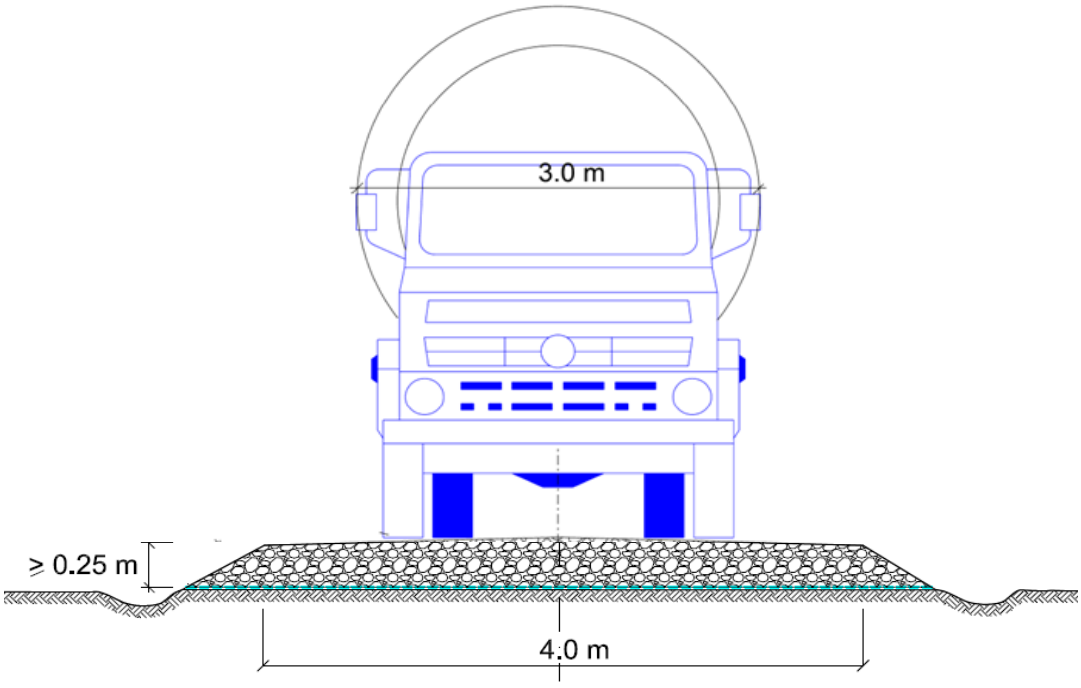


Fig. 8.5 – Dimension for concrete pipes transport for TAP microtunnel

8.4.2 MTBM transport

The expected MTBM (see Fig. 8.6) to be mobilized for TAP project could have a total weight and dimension as follows:

- L_{as}= 6,6 m.
- Weight = 70 tons (the total equipment and relevant weight could be dismounted in two part for transport purpose)

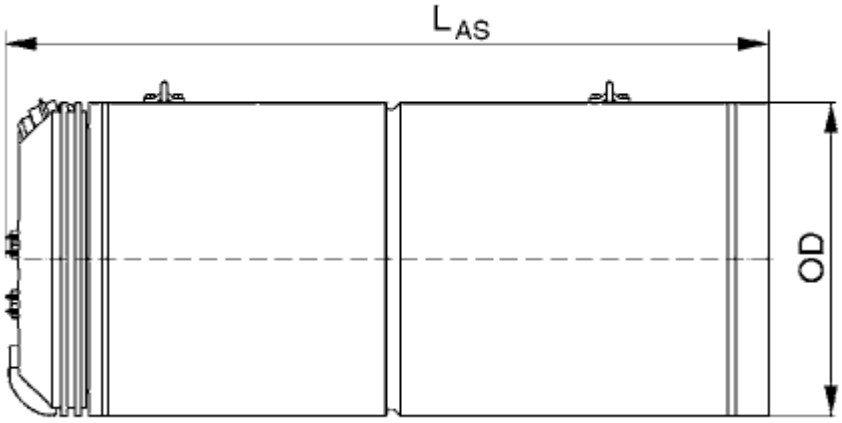


Fig. 8.6 – MTBM transport

8.4.3 Linear winch transport

After microtunnel construction the activities relevant to the pipeline installation will start. For pipeline pulling inside the microtunnel a linear winch shall be mobilized and installed within the LCY.
The dimension and weight for such size of winch (indicatively 600 t capacity) could be as follows, and shall be moved by trailer (see Fig. 8.7):

- Dimensions (L x W x H) = 13m x 3,2m x 1,3 m
- Weight = 80 t (two frames 40 t each)

Fig. 8.7 – Linear Winch transportation

9 PROPOSED ACCESS ROAD

9.1 Design Concept

The new access road shall be developed inside the working strip for future pipeline ROW as indicated in Fig. 9.1. No underground services are currently present in the vicinity of the work area.

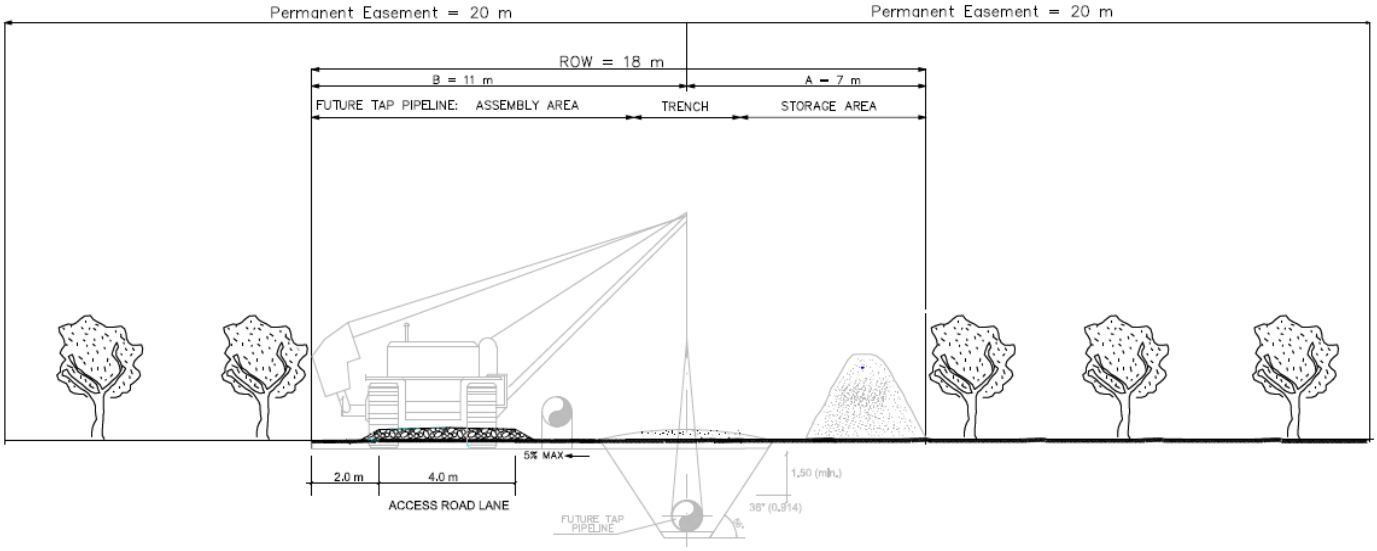


Fig. 9.1 – New Access Road typical cross section within "future" pipeline ROW

9.2 Construction issues

The access road construction will commence at an early phase of the project to obtain access to the microtunnel LCY. All the elements involved in constructing the site access road will be grouped together and will be awarded to a specialised Contractor. As the tunnelling site will not be accessible, there will be a limited amount of site facilities and amenities that will be hired for the duration of construction.

The required water supply for the construction works shall be done through a connection to the existing water supply network, using a water meter device, when construction works take place near inhabited areas. Should this not be the case, Contractor shall take appropriate measures to provide the required water supply and/or transport the water where needed from the designated sources. A permit to take water has to be obtained during the mobilization phase with the respective Authorities.

The electricity supply shall take place through a connection to the existing electricity supply network, using an electricity measurement device, when construction works take place near inhabited areas. Otherwise Contractor shall take appropriate measures to provide the required electricity supply over generators. As for the water connection a

permit to connect to the existing electricity network is needed to be obtained by relevant Authorities during the mobilization phase and prior to proceed with any Connection.

Topography data and drawings (ref. 8) will be handed over to Contractor. It will be Contractor's responsibility to erect and maintain the relevant benchmarks and set out the road alignment. Contractor benchmark will be used to control the works during their development.

Site fencing will be erected at the start of the access road work, the affected the area will be locked up and secured overnight. First aid facilities and fire extinguishers will be available at site. There will be no need of oversized loads or special haulage requirements during the access road construction. All works undertaken will be performed during daylight hours and will be subject to Cultural Heritage Approval.
Once the final alignment of the access road is confirmed, the route will be surveyed and pegged for clearing operations to commence.

For the site access road preparation it is expected that the following equipment will be mobilised to site: excavator, grader, roller, water cart, and trucks.
However it will be up to Contractor to estimate the number of machineries and equipment needed to implement the contract appropriately and in timely manner.

The constructed “temporary” access road will be classed as a private road and all vehicles during the access will need to comply with the standard road rules and regulations. The site will have one designated entry and exit location where all traffic movements in and out the site will be undertaken as per normal road conditions.

The clearing and grubbing will be the first activity to commence the access road construction. The access road alignment is situated in an olive trees plantation area. The clearing operation will be undertaken using an excavator along the length of the road.
The clearing of the vegetation will be done by removal of olive trees that shall be properly stored for final replacement after access road and pipeline construction work completion. The smaller bushes will be mulched.

The works involved to build the access road consists in preparing the subgrade and placing embankment material. Prior to placing the embankment material the subgrade will need to be prepared.
Typically existing subgrade material will need to be scarified approximately 150 mm deep using the tines on the grader and re-compacted with a vibrating roller. The ground surface will need to be tested at this stage to ensure the relative compaction has been achieved. Any unsuitable material will need to be removed and replaced with a suitable one.

Once the subgrade compaction has been achieved, a final trim by grader will be completed and any irregularity will be reshaped accordingly. The affected area of the new access road is almost flat, current cut and fill estimates show that existing cut material available on-site should balance the fill quantity required to construct the subgrade.

Embankment construction will commence immediately after the subgrade has been completed. Fill material, if necessary, shall be imported from a local quarry and will progressively tip material out along the length of the subgrade.
Embankment material will be placed using the layer compaction method typical in road construction.
Each layer for paving completion will be spread and tested prior to place the next layer of fill. Water will need to be added to the material at various stages to ensure the optimum moisture content of the material is maintained.

Material at its optimum moisture content will be easier to compact and will provide a greater surface finish.
Upon completion of placing, the embankment material will require a final trim by grader.

9.3 Layout of curvature at point C (T junction on municipal road)

The most critical point along the roads where trailers have to transit is represented by the presence of sharp curve for the connection of the new access road with existing municipal road S.Niceta.

The design width of the carriageway has to ensure the manoeuvrability of the trailer in the curve.
For the determination of the roadway enlargement value in correspondence of the curves reference is made to the DM of 05.11.2001 (see ref. 23).

In section 5.2.7 of the mentioned code the enlargement is defined by the following formula:

$$E = K / Re \ (*)$$

Where:

E = carriageway enlargement expressed in m;
K = 45;
Re = external radius (m) of the carriageway

In the present case, the road will be used in one way, during transit of heavy vehicles; hence the value of the calculated enlargement is equal to the entire carriageway.

The required turning radius is taken from the AASHTO Design guide 3rd edition 2006, for semitrailer vehicle the considered radius is 13,7 m.

Thus, using this radius in the formula the value to be considered is:

$$Re = 13,7 + (L/2) = 15,7 \text{ m.}$$

where L= width of the carriageway (4 m);

The required carriageway enlargement results the following:

E= 2,87 m

Therefore, the minimum enlarged carriageway in the curve at point C is:

L_{cc}=6,9 m.

Conservatively, the width of carriageway in the curved section is designed:
L_{curve} = 8 m.

The edges of the curved enlargement shall have a connection to the normal carriageway following the geometrical design recommendation given by ASHHTO standard shown in Fig. 9.3.

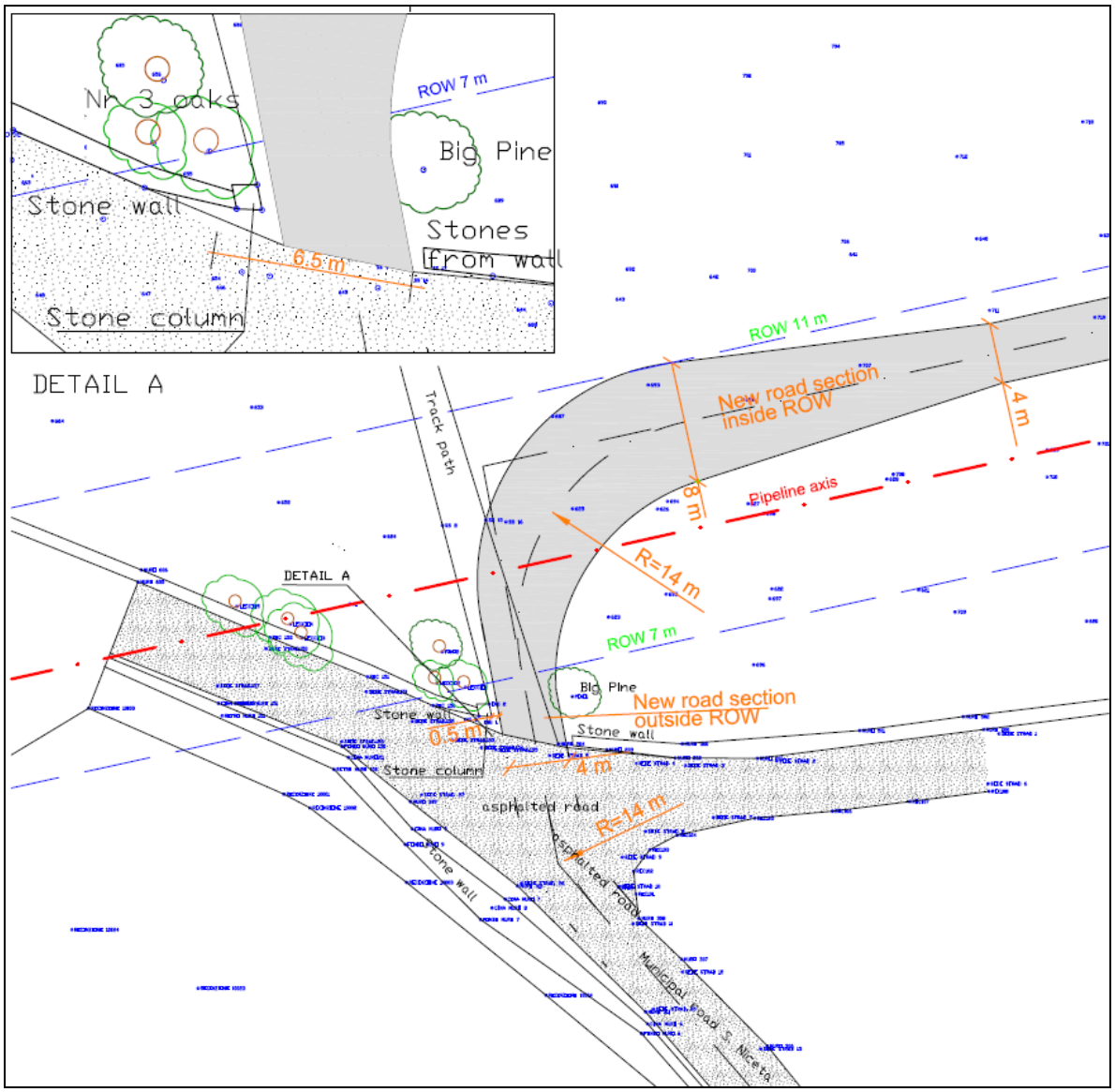
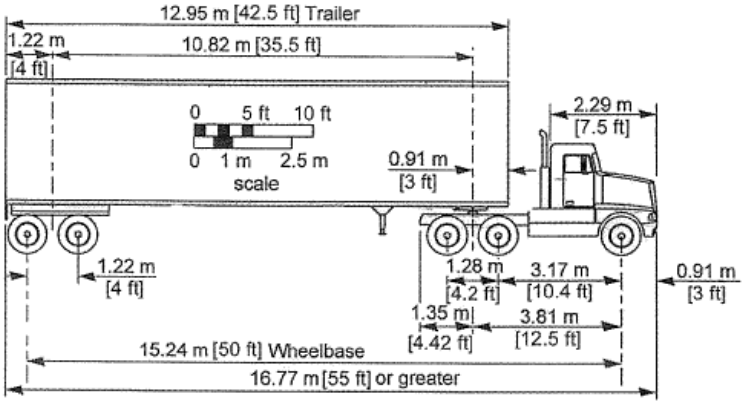


Fig. 9.2 – Detail for enlargement of existing curve at point C (existing T junction)



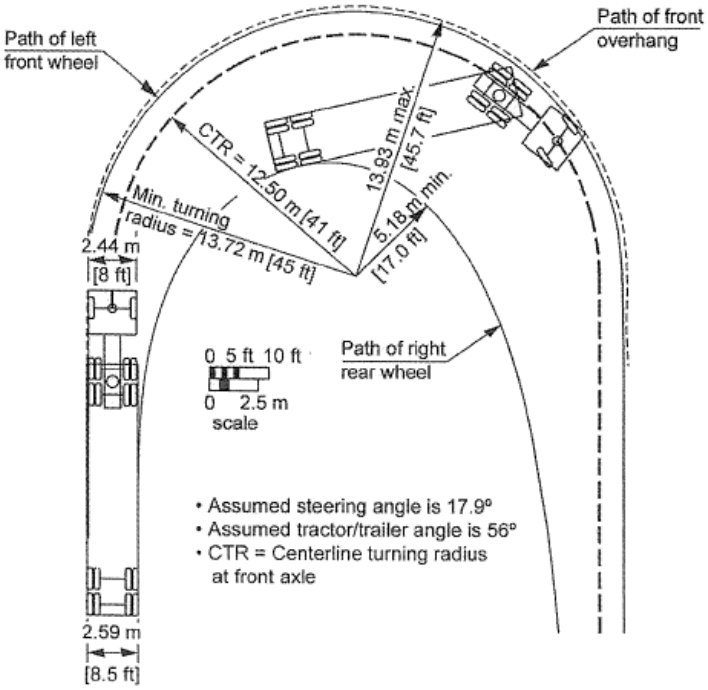


Exhibit 2-14. Minimum Turning Path for Intermediate Semitrailer (WB-15 [WB-50])

Fig. 9.3 – AASHTO standard for minimum turning lane for semitrailer

10 HEALTH, SAFETY & ENVIRONMENT

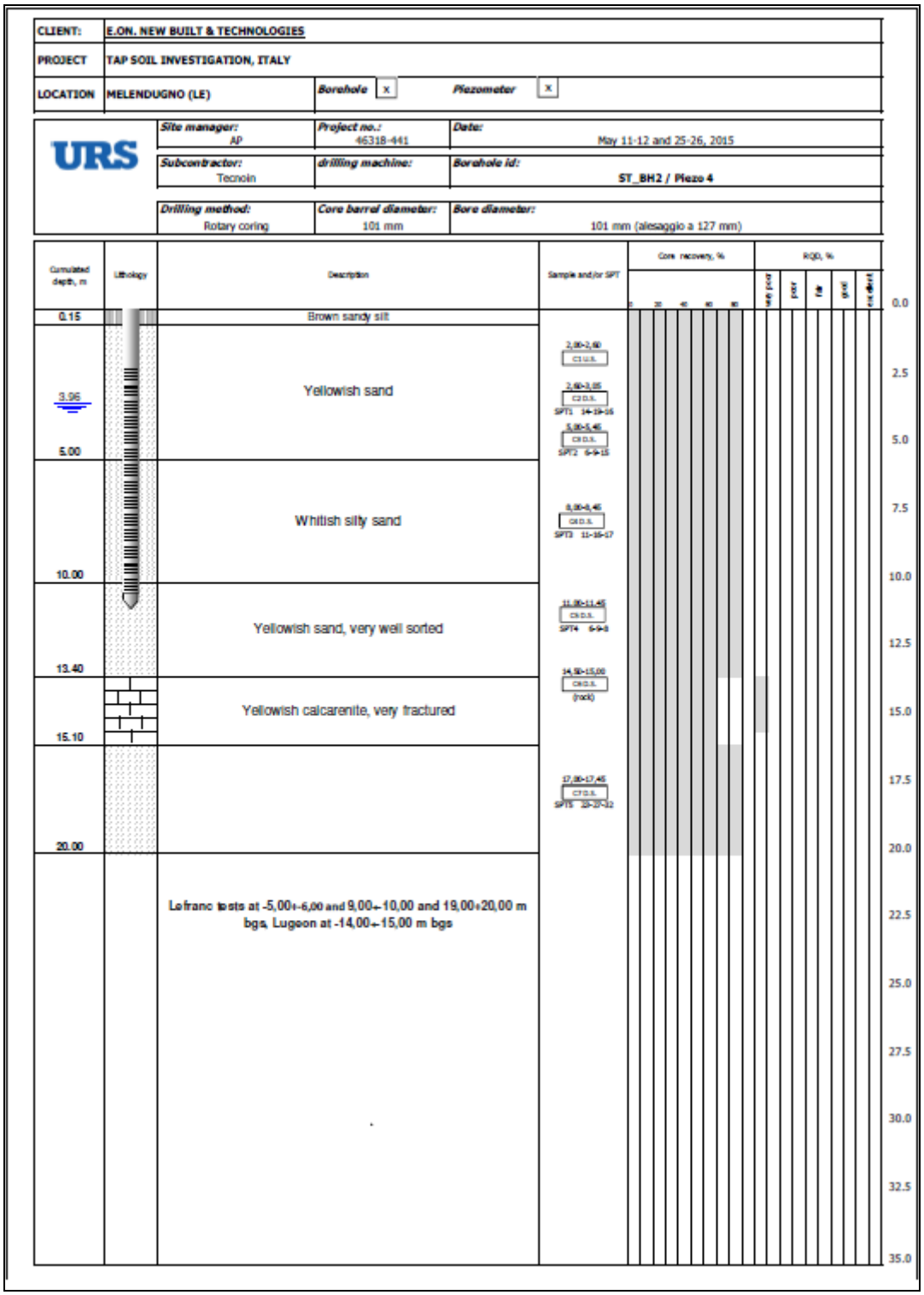
Effective H&S and Environmental Management are considered essential to the successful execution of the Project in line with Company policy, regulatory and legal requirements.
As far as the new access road section from point C to the tie-in point at the LCY the following HSE considerations shall be applied.

All applicable work permits, intrinsically safe working equipment and all related H&S activities, including PPE requirements, shall be controlled by the H&S Manager or nominee, strictly in accordance with the requirements of the Health & Safety Management Plan and related documentation.

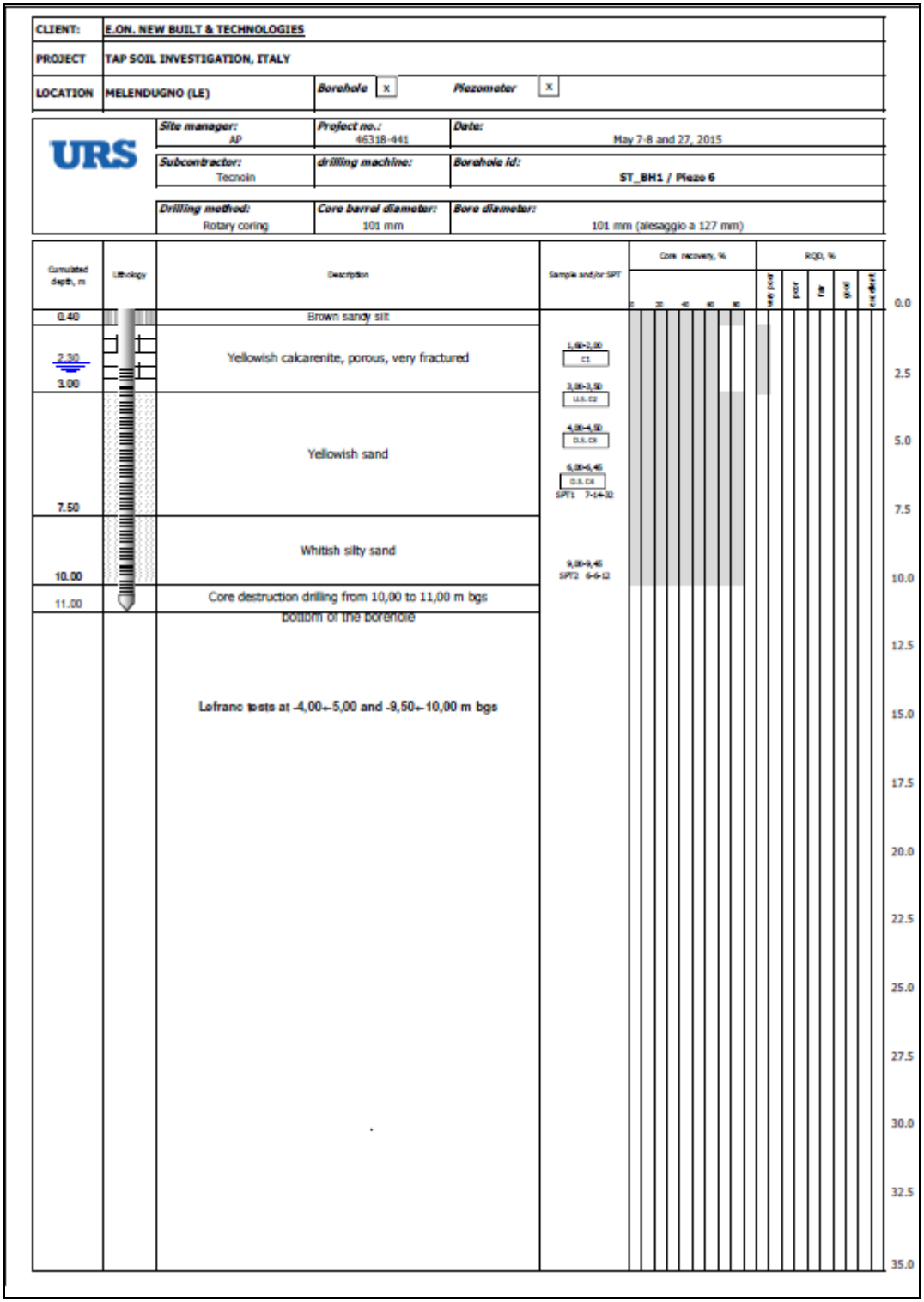
All items of plant and equipment to be utilised in the access road construction shall be inspected and certified fit for purpose. Plant operators shall hold appropriate license or national certification issued by an accredited organization. All plant will need to be accompanied by weed hygiene declarations prior to mobilising to site. Plant operators shall not transfer control of their machines to any other person without the express consent of their supervisors.

All plant and equipment operators must supply a Certified Certificate of Competency as per the Work Place health and Safety regulations. PPE when operating the machine is subject to the plant risk assessment. Daily prestart talks will be undertaken to address upcoming activities and changes in the working environment.
All reasonable steps will be taken to comply with any agreements in relation to third party infrastructure. Applicable safety advice notices will be lodged and appropriate permits obtained where applicable prior to the commencement of any works.

11 APPENDIX (BOREHOLE LOGS)



Borehole BH 2/ Piezo 4



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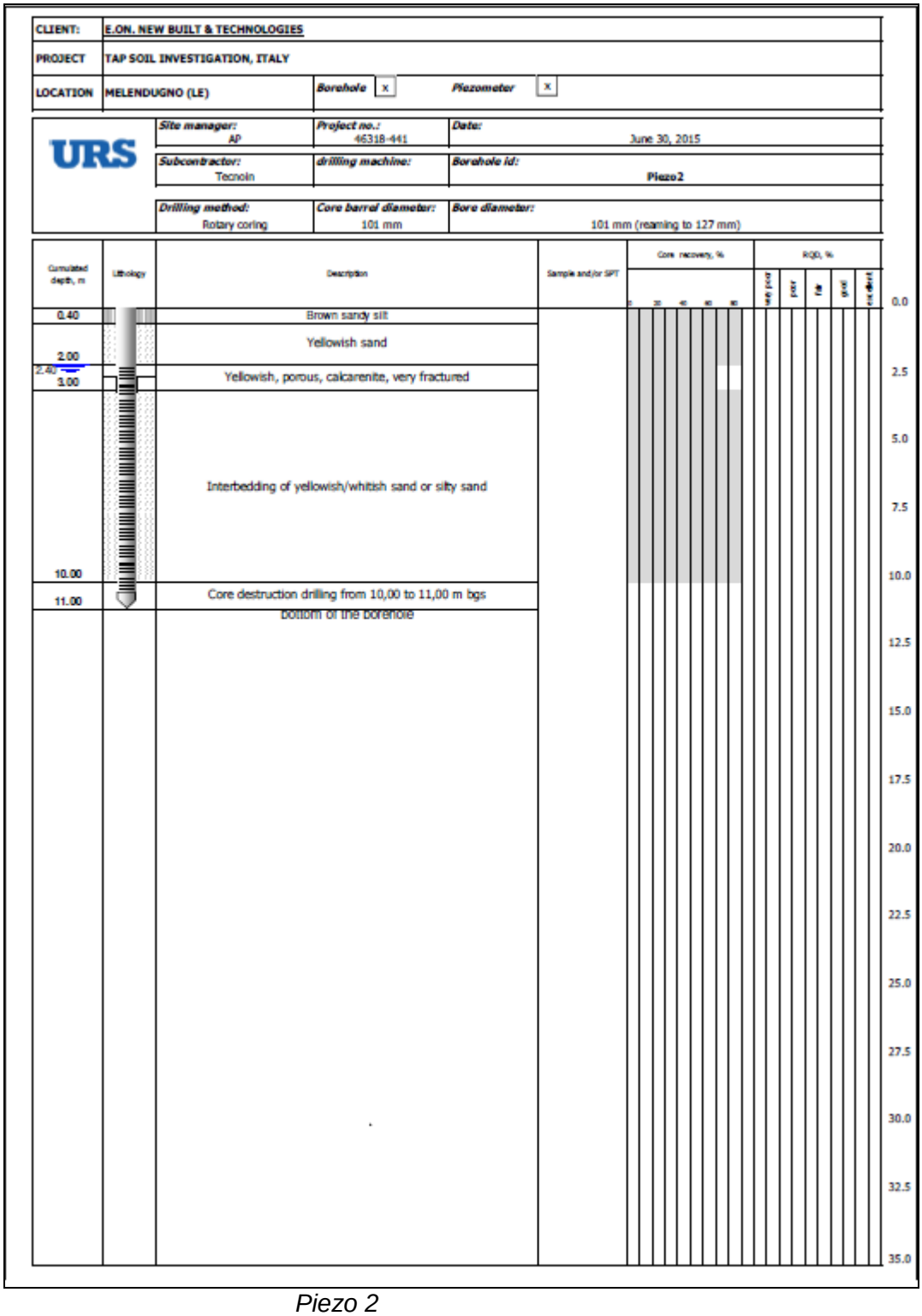
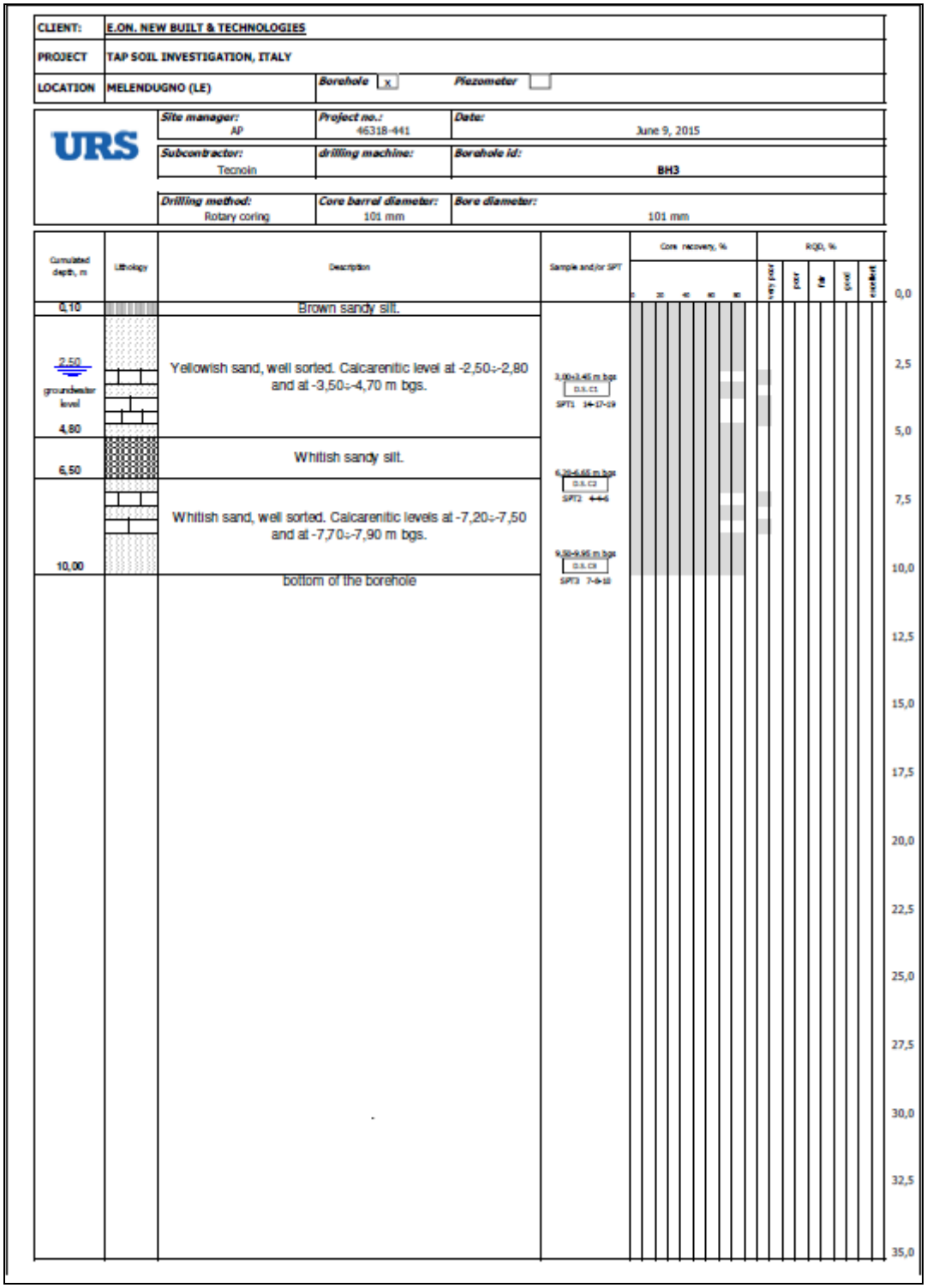

CLIENT: E.ON. NEW BUILT & TECHNOLOGIES
PROJECT TAP SOIL INVESTIGATION, ITALY
LOCATION MELENDUGNO (LE)
Borehole x
Piezometer x
URS
Site manager: AP
Project no.: 46318-441
Date: June 30, 2015
Subcontractor: Tecnoin
drilling machine:
Borehole id: Piezo2
Drilling method: Rotary coring
Core barrel diameter: 101 mm
Bore diameter: 101 mm (reaming to 127 mm)
Cumulated depth, m
Lithology
Description
Sample and/or SPT
Core recovery, %
RQD, %
0.40 Brown sandy silt
2.00 Yellowish sand
2.40
3.00 Yellowish, porous, calcarenite, very fractured
Interbedding of yellowish/whitish sand or silty sand
10.00
11.00 Core destruction drilling from 10,00 to 11,00 m bgs
Bottom of the borehole
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
30.0
32.5
35.0

Piezo 2



Borehole BH 3

12 REVISION RECORD

Rev.	Date	Description
A	07.09.2015	Issued for IDC
0A	11.09.2015	Issued for Review
0B	18.09.2015	Re-issued for Review
00	28.01.2016	Issued for Construction