REGIONE PUGLIA
Comune di Serracapriola
Provincia di Foggia

Studio di Ingegneria
Ing. Nicola Roselli - Termoli (CB)
email ing.nicolaroselli@gmail.com

ATLAS RE
Energy for the Future

PROGETTO DEFINITIVO

PROGETTO PER LA COSTRUZIONE ED ESERCIZIO DI UN IMPIANTO AGRIVOLTAICO NECESSARIO ALLA PRODUZIONE DI ENERGIA ELETTRICA DA FONTE FOTOVOLTAICA CON ASSOCIATO IMPIANTO APIARIO E DELLE RELATIVE OPERE ED INFRASTRUTTURE CONNESSE DELLA POTENZA NOMINALE MASSIMA DI 46632 KW E POTENZA IN A.C. DI 40000 KW, SITO NEL COMUNE DI SERRACAPRIOLA (FG)

TITOLO TAVOLA

RELAZIONE GEOTECNICA

PROGETTAZIONE	PROPONENTE	SPAZIO RISERVATO AGLI ENTI
PROGETTISTI Ing. Nicola ROSELLI Ing. Rocco SALOME PROGETTISTI PARTI ELETTRICHE Per.Ind. Alessandro CORTI CONSULENZE E COLLABORAZIONI Arch. Gianluca DI DONATO Dott. Massimo MACCHIAROLA Ing. Elvio MURETTA Archeol. Gerardo FRATIANNI Geol. Vito PLESCIA	**LIMES 7 S.R.L** SEDE LEGALE Milano, cap 20121 via Manzoni n.41 P.IVA 10307690965 Dott. VITO FRANCESCO PLESCIA – ORDINE GEOLOGI REGIONE MOLISE – ALBO SEZ. A N. 39 – Geologo Specialista	

4.2.3	FILE	CODICE PROGETTO	SCALA
	1YLY2F7_4.2.3_RelazioneGeotecnica	1YLY2F7	

REVISIONE	DATA	DESCRIZIONE REVISIONE	REDATTO	VERIFICATO	APPROVATO
A	16/01/2023	EMISSIONE	PLESCIA	LIMES7	LIMES7
B					
C					
D					
E					
F					

,1',&(

$//(*$7,

7$%(//((*5$),&, 3529(3(1(7520(75,&+(

7$%(//((*5$),&, 3529(6,60,&+(

7$%(//$ &$/&2/2 '(/ 9V (TX

7$92/($//(*$7( )250$72 $

7$9 3/$1,0(75,$ 6$7(//,7$5(,03,$172 $*5,92/7$,&2

7$9 3/$1,0(75,$ 8%,&$=,21($5(($//2 678',2 6FDOD

7$9 &$57$ *(2025)2/2*,&$,03,$172 $*5,92/7$,&2 6FDOD

7$9 &$57$ 3$, '(//$ 3(5,&2/26,7$¶ ,'5$8/,&$,03,$172 $*5,92/
6FDOD

7$9 &$57$ 3$, '(/5,6&+,2 ,'5$8/,&2 ,03,$172 $*5,92/7$,&2 6FI

7$9 &$57$ 3$,)$6&,$ '(/5,$66(772)/89,$/(,03,$172 $*5,92/7
6FDOD

7$9 &$57$ *(2/2*,&$,03,$172 $*5,92/7$,&2 6FDOD

7$9 &$57$ /,72/2*,&$,03,$172 $*5,92/7$,&2 6FDOD

35(0(66$

3HU FRQWR GHOOD 6RFLHWj /,0(6 6 5 / FRQ VHGH L
*HRORJR 3OHVFLD 9LWR)UDQFHVFR LVFULWWR DOO¶$OE
5HJLRQH 0ROLVH DO Qƒ VH] $ ³*HRORJL 6SHFLDOLVWL´
GHO SURJHWWR GHILQLWLYR DXWRUL]]D]LRQH XQLFD DL V
GL XQ LPSLDQWR DJULYROWDLFR QHFHVVDULR DOOD SURG
DVVRFLDWR LPSLDQWR DSLDULR H GHOOH UHODWLYH RSHU
PDVVLPD GL .: H SRWHQ]D LQ D F GL .: GD UHDO
)* LQ ORFDOLWj 6SDQGLWXUR 1HOOH DUHH LQ HVDPH
ORFDOH GHO FDPSR DJULYROWDLFR H SHU FRQRVFHUH L S
VWDWH HIIHWWXDWH GXH SURYH SHQHWURPHWULFKH GLQD
ULVSRVWD VLVPLFD ORFDOH DL VHQVL GHO ' 0 H
JHQQDLR VRQR VWDWH HIIHWWXDWH GXH SURYH VLVP
PLFURWUHPRUL 3HU OD UHGD]LRQH GHOOH FDUWH WHPD
VRQR VWDWL XWLOL]]DWL L GDWL GHOOD FDUWD JHRORJ
5HJLRQH 3XJOLD L GDWL GHOO¶DXWRULWj GL EDFLQR 3
ULVXOWDQ]H GL FKH WUDWWDVL H OH FRQVLGHUD]LRQL HP

9,6,21(6$7(//,7$5('(//($5((2**(772 '(//¶,17(59(172

Legenda
- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico
- Cabina MT campo agrivoltaico
- Futura stazione Terna
- Linea Mt

,148$'5$0(172 7232*5$),&2 (*(2025)2/2*,&2 '(//($5((2**(77

'(// ,17(59(172

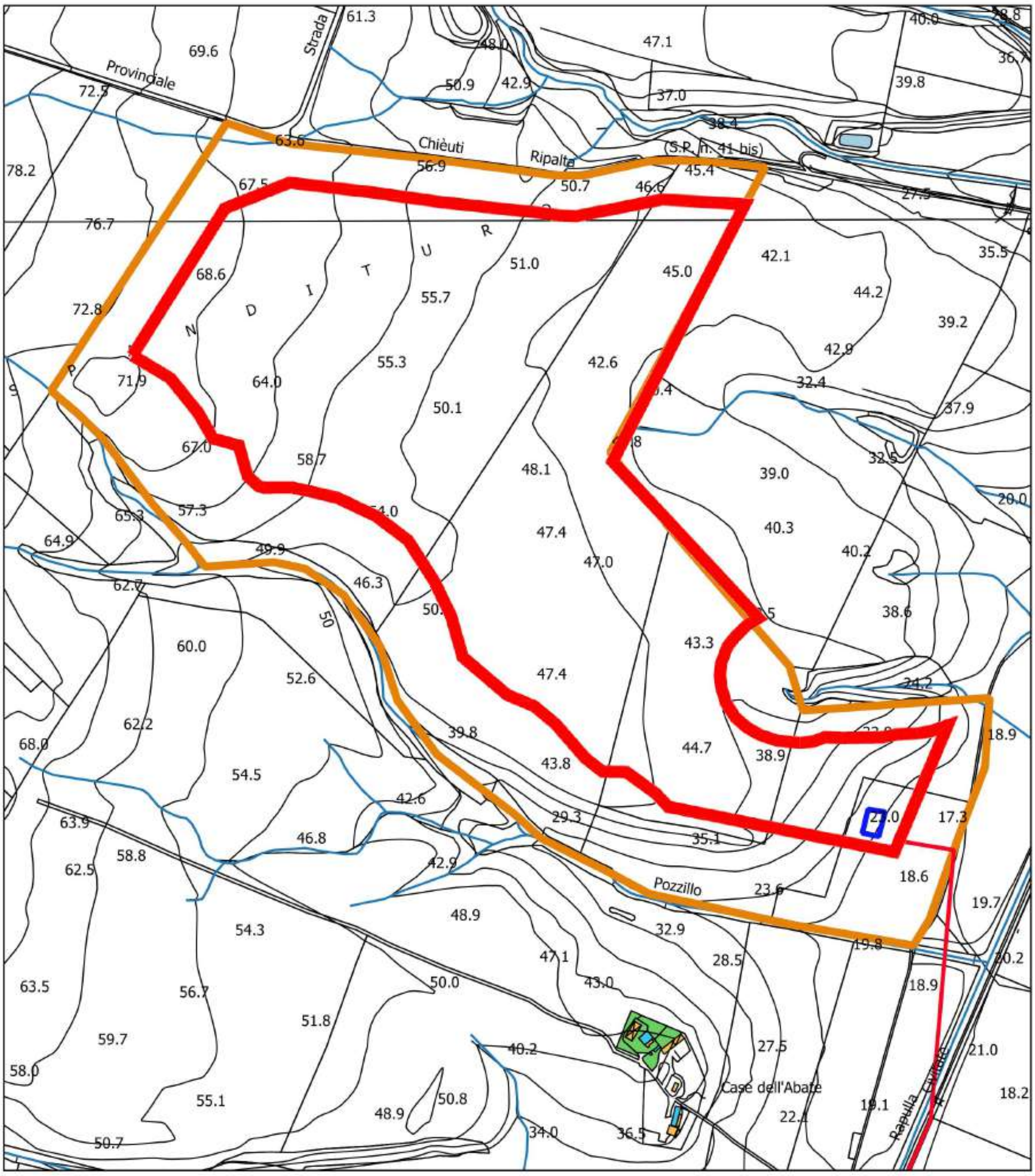
,O WHUULWRULR LQWHUHVVDWR GDO SUHVHQWH VWX

Qƒ 6DQ 6HYHUR H QHOOH &DUWH 7HFQLFKH 5HJL

DOOD VFDOD

LQWHUHVVDWD GDL SDQQHOOL IRWRYROWDLFL ULHQWUD Q
D QRUG GDOOD 0DVVHULD &KLDQWLQHOOH DG HVW GDOOD
VXG GDOOH &DVH GHOO¶$EDWH HG LQILQH DG RYHVW GDO
DSSDUWHQJRQR DO EDFLQR LGURJUDILFR GHO))RUWRUH
YHUVR (VW HG DOWLPHWULFDPHQWH q SRVWD D TXRWH PL
SHQGHQ]D PDVVLPD GHO TXDVL SLDQHJJLDQWH (VVD q
R PHQR HVWHVH FKH ORFDOPHQWH IDQQR VSDUWLDFTXH
HQWUDPEL WULEXWDUH GHO))RUWRUH ,Q WDOL DUHH
QDWXUDOPHQWH FRQGL]LRQDWD GDOOD QDWXUD GHO VXEV
GHOOH FDUWH 3$, GDOOD OHWWXUD GHOOH FDUWH JHRP
ULVXOWDQR LQWHUHVVDWH GD SHULFRORVLWj H ULVFKL
LGURJHRORJLFR LQ TXDQWR O¶DUHH SUHVHQWDQR XQD ED
IHQRPHQL IUDQRVL 3HUWDQWR QHOOH DUHH DOOR VWXGL
IUDQRVL LQ DWWR R SRWHQ]LDOL IHQRPHQL TXLHVFHQWL
UXVFHOODPHQWR DFFHOHUDWR

,O WHUULWRULR LQWHUHVVDWR GDOO¶LPSLDQWR DJU
SUHVHQWD VWDELOH H SULYR GL IHQRPHQRORJLH HYHUVLY
QHOOH FDUWH GHO ULVFKLR H SHULFRORVLWj LGUDXOLFD
$VVHWWR ,GURJHRORJLFR 9HG 7DYROH

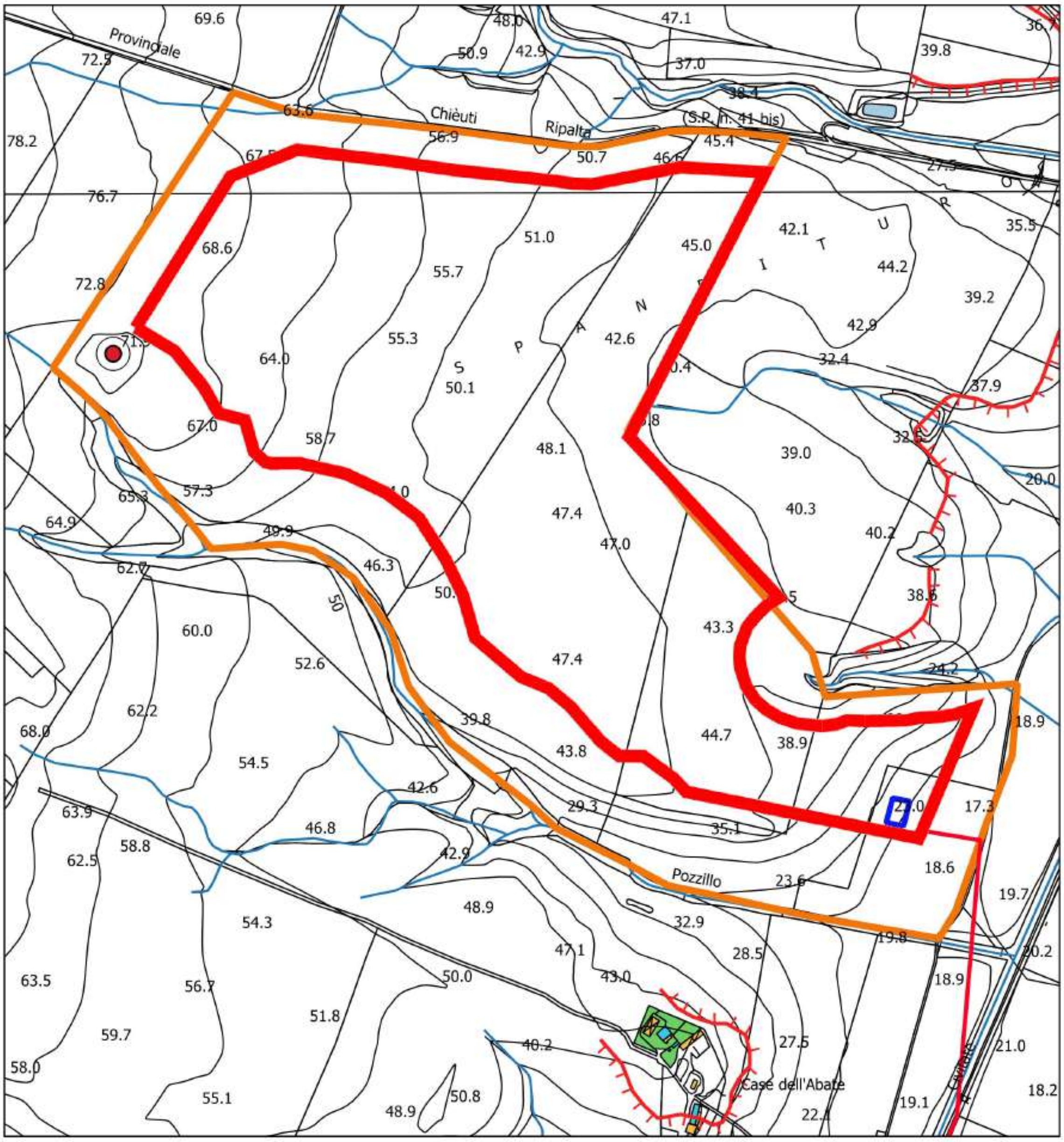


PLANIMETRIA UBICAZIONE IMPIANTO AGRIVOLTAICO

Legenda

- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico
- Cabina MT campo agrivoltaico
- Sottostazione Terna
- Linea Mt

Scala 1 : 8.000



CARTA GEOMORFOLOGICA IMPIANTO AGRIVOLTAUCO

Legenda

- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico
- Cabina MT campo agrivoltaico
- Futura stazione Terna
- Linea Mt

geomorfologia

- 382_reticolo
- 382_orli_terrazzo_morfologico
- 382_nicchie
- 382_vette
- 382_punti_sommitali
- 382_corpi_frana
- 382_creste
- 382_cave

Scala 1 : 8.000

352*(772 3$,)25725(

,O 3URJHWWR 3$, q ILQDOL]]DWR DO PLJOLRUDPHQWR
VWDELOLWj JHRPRUIRORJLFD LQGLYLGXD H QRUPD SHU O
ULVFKLR LGUDXOLFR H OH DUHH D SHULFRORVLWj H ULVFK
/H DUHH D SHULFRORVLWj LGUDXOLFD LQGLYLGXDWH GDO
GL ULVFKLR LQ

$5(($ 3(5,&2/26,7$¶ ,'5$8/,&$

$UHH D SHULFRORVLWj LGUDXOLFD DOWD ± 3,
$UHH D SHULFRORVLWj LGUDXOLFD PRGHUDWD ± 3,
$UHH D SHULFRORVLWj LGUDXOLFD EDVVD ± 3,

$5(($ 3(5,&2/26,7$¶ *(2025)2/2*,&$

$UHH D SHULFRORVLWj GD IUDQD HVWUHPDPHQWH HOHY
$UHH D SHULFRORVLWj GD IUDQD HOHYDWD ± 3)
$UHH D SHULFRORVLWj GD IUDQD PRGHUDWD ± 3)

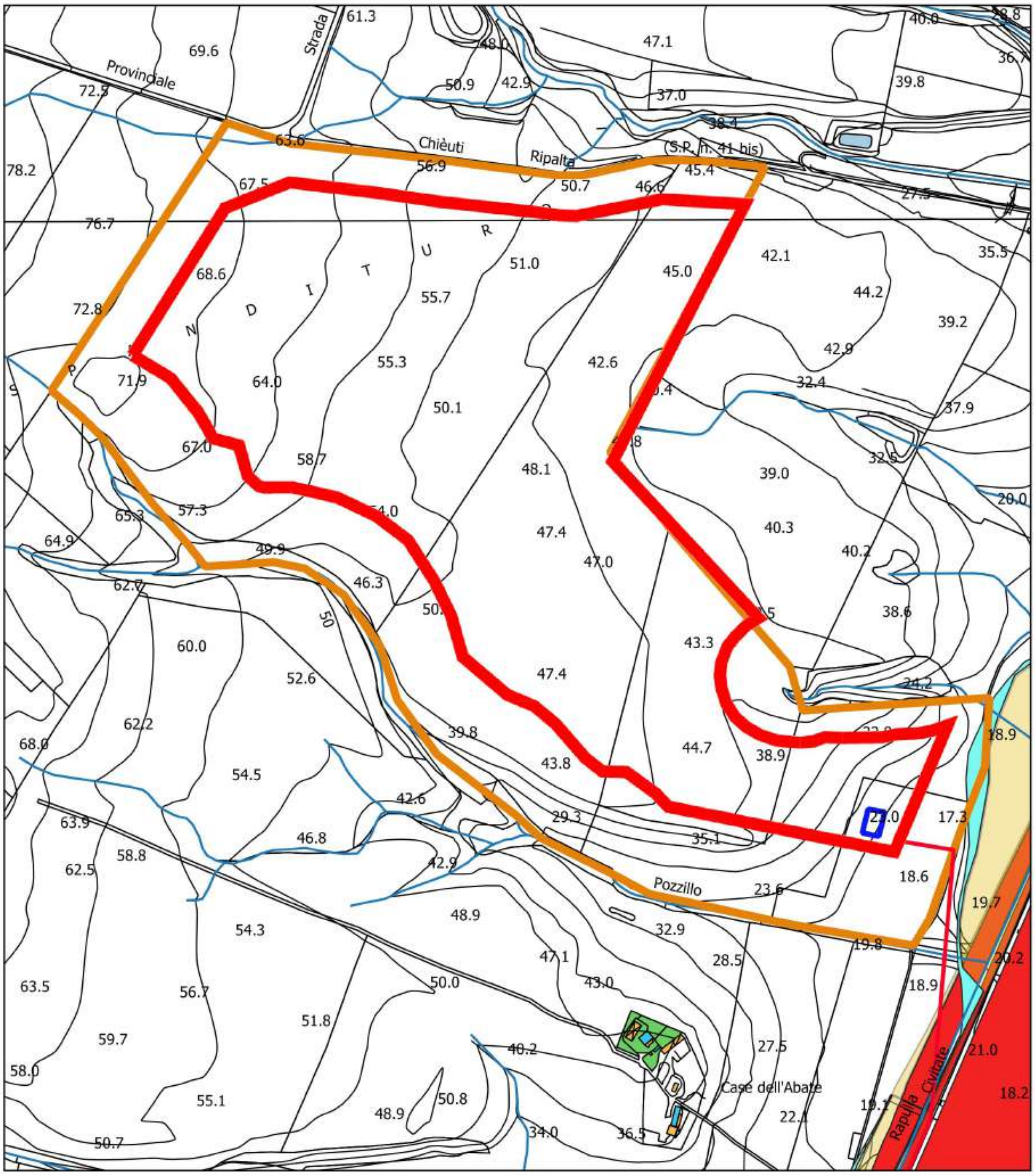
$5(($ 5,6&+,2 ,'5$8/,&2

$UHH D ULVFKLR LGUDXOLFR PROWR HOHYDWR ± 5,
$UHH D ULVFKLR LGUDXOLFR HOHYDWR ± 5,
$UHH D ULVFKLR LGUDXOLFR PHGLR ± 5,
$UHH D ULVFKLR LGUDXOLFR PRGHUDWR ± 5,

$5(($ 5,6&+,2)5$1$

$UHH D ULVFKLR IUDQD PROWR HOHYDWR ± 5
$UHH D ULVFKLR IUDQD HOHYDWR ± 5
$UHH D ULVFKLR IUDQD PHGLR ± 5
$UHH D ULVFKLR IUDQD PRGHUDWR ± 5

1HOOH DUHH DOOR VWXGLR 9HG 7DY GDOOH YHUL
LGUDXOLFD H SHULFRORVLWj GD IUDQD HG q DVVHQWH LO
ULVSHWWDWD OD GLVWDQ]D SUHYLVWD QHOOH QRUPH 3$,)



CARTA PAI DELLA PERICOLOSITA' IDRAULICA IMPIANTO AGRIVOLTAICO

Legenda

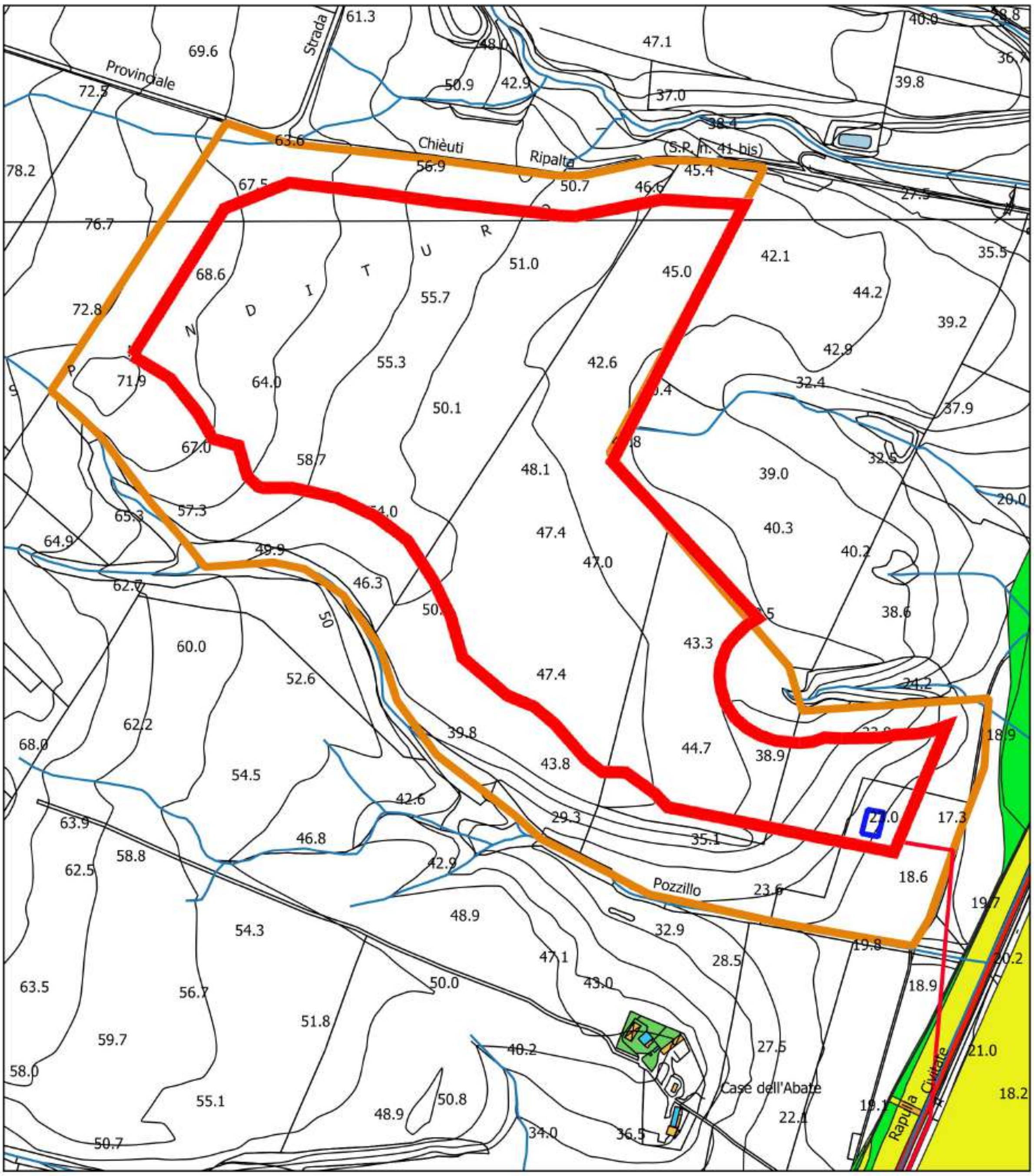
- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico
- Cabina MT campo agrivoltaico
- Sottostazione Terna
- Linea Mt

PAI Fortore

Pericolosita_idraulica

- PI3
- PI2
- PI1

Scala 1 : 8.000



CARTA PAI DEL RISCHIO IDRAULICO IMPIANTO AGRIVOLTAICO

Legenda

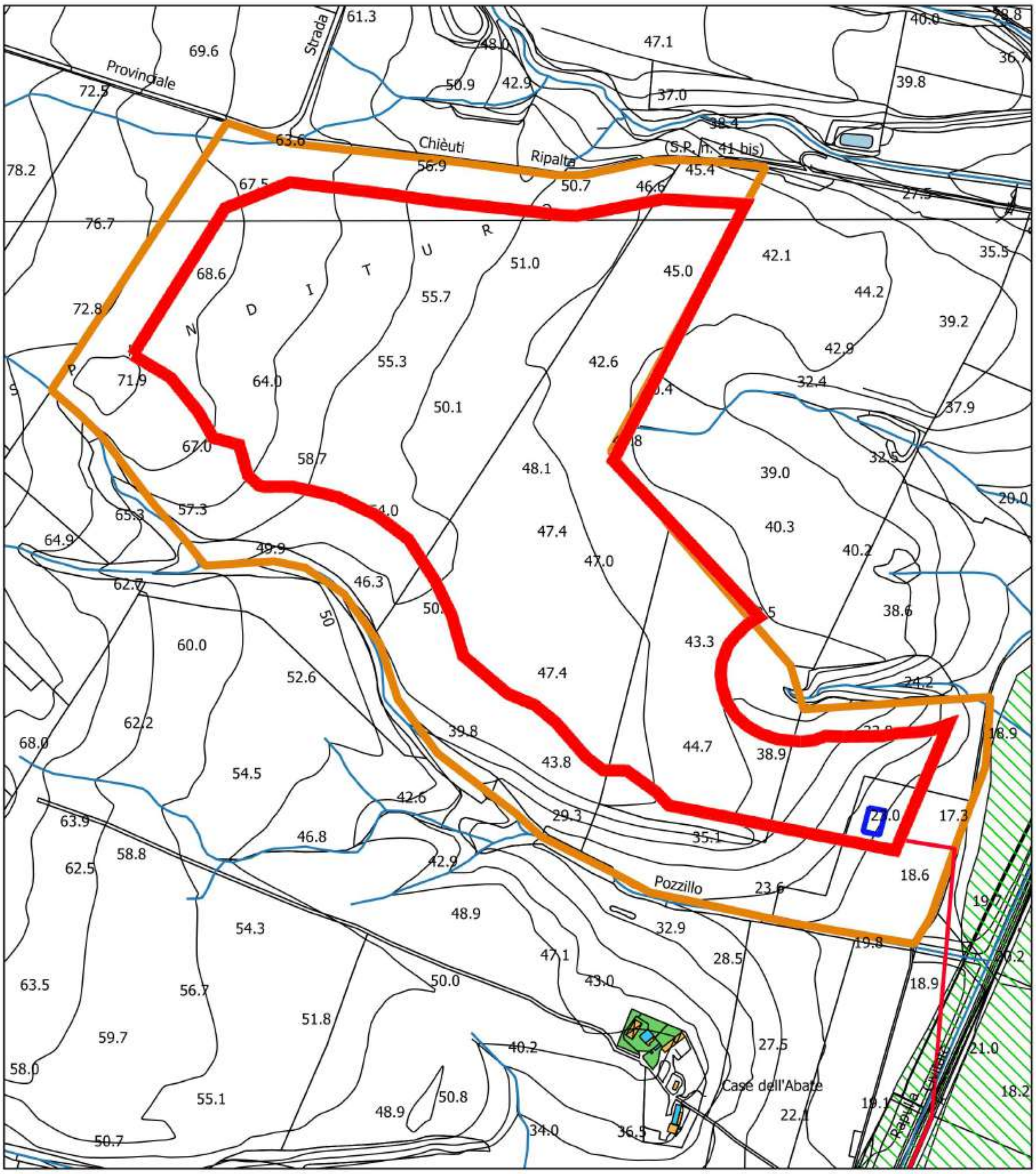
- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico
- Cabina MT campo agrivoltaico
- Sottostazione Terna
- Linea Mt

PAI Fortore

Rischio_idraulico

- RI4
- RI3
- RI2
- RI1

Scala 1 : 8.000



CARTA PAI FASCIA DI RIASSETTO FLUVIALE IMPIANTO AGRIVOLTAICO

Legenda

- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico
- Cabina MT campo agrivoltaico
- Sottostazione Terna
- Linea Mt

PAI Fortore

- Fascia di riassetto fluviale

Scala 1 : 8.000

(2/2,$

/D JHRORJLD GHO WHUULWRULR LQWHUHVVDWR GDOO¶

WHUUHQL GL RULJLQH PDULQD OD FXL HWj q FRPSUHVD V

7DY 'DO EDVVR YHUVR O¶DOWR VL VXVVHJXRQR

)250$=,21, ', *(1(6, 0$5,1$

$UJLOOH GL 6L0RQWDWWHFFRL DUJLOOH PDUQRVH VLOWRV
VXSHUILFLH SHU DOWHUD]LRQH FRQ YHOL GL VL W H UDUH
IUHTXHQWL DOOD VRPPLWj GHOOD IRUPD]LRQH FKH SDVVD
6HUUDFDSULROD %DQFKL GL VDEELD SRWHQWL TXDOFKH G
PHGLD GHOOD IRUPD]LRQH /R VSHVVRUH q GL GLIILFLOH Y
'DL GDWL GL SHUIRUD]LRQH VL GHVXPH FKH VLD PROWR QR
GHOO¶RUGLQH GHL PHWUL QHOOD]RQD IUD 6HUUDF
VSRQGH GHO))RUWRUH DG RYHVW GHOO¶DUHH DOOR V
0HGLR

6DEELH GL 6/HU6DEELHSHLGROD6HUUDFDSULROD VRQR FRVW
JLDOODVWUH TXDU]RVH LQ JURVVL EDQFKL D OXRJKL VRQ
FHPHQWDWH DUJLOOH ELDQFDVWUH R YHUGH FKLDUR 1R
HOHPHQWL SUHYDOHQWHPHQWH DUHQDFHL H FDOFDUHR P
0RQWHVHFFR DOOH TXDOL SDVVDQR JUDGXDOPHQWH SHU
OLPLWH IUD OH GXH IRUPD]LRQL q VWDWR SRVWR FRQYH
SRWHQWL FDUDWWHUL]]DWL GDOOD SUHVHQ]D GL LQWHUF
SL• JURVVRODQD 2YH LO SDVVDJJLR q SL• QHWWR OH 6
PRUIRORJLFD VXOOH WHQHUH DUJLOOH VRWWRVWDQWL /
FLUFD P GLYHQWD TXL SL• FRQVLGHUHYROH $IILRUD VX
VWXGLR /¶HWj q DVFULYLELOH DO &DODEULDQR 3OLRFHQH

&RQJORPHUDWL G6L R&QRFPRSQRVLWXLRWL GD OHQWL H OHWW
WDOYROWD FRQ OLYHOOL GL FRQJORPHUDWL FRPSDWWL
LQFURFLDWD HG LQWHUFDOD]LRQL GL DUJLOOH YHUGDVWU
WUDWWDQGRVL GL PDWHULDOH SURYHQLHQWH GDOOH IRU

PDUQRVL GL DUHQDULH H ORFDOPHQWH GL FULVWDOOLQ
DEEDVWDQ]D SURQXQFLDWR q LO JUDGR GL DSSLDWWLPH
SDVVDJJLR DOOH VRWWRVWDQWL 6DEELH GL 6HUUDFDSU
GLVFRUGDQ]D DQJRODUH QHOOH]RQH SL• LQWHUQH /R V
SURVVLPD DOOD FRVWD TXL VL RVVHUYDQR JOL DIILRUD
VFDUSDWD GL DEUDVLRQH PDULQD VSHFLH QHL SUHVVL G
QDWXUD GHO VHGLPHQWR H OD ORFDOH SUHVHQ]D QHL O
IRUPD]LRQH UDSSUHVHQWL OD IDVH ILQDOH GHOOD UHJ
DOOXYLRQDPHQWR , &RQJORPHUDWL Gu &DPSRPDULQR
VXSHUILFLDOH SHU DOWHUD]LRQH 1HO IRJOLR ULOHYDWF
VWXGLR /¶HWj q DVFULYLELOH DO 3RVWFDODEULDQR &DOD

)250$=,21, ', *(1(6, &217,1(17$/(

&RSHUWXUH IOXYLR ODFXVWUL GHL,SLDQRVDOWL H VXSHUL,,RU
VRQR FRVWLWXLWL SUHYDOHQWHPHQWH GD JKLDLH VDEE
VXSHUILFLDOH GL WHUUH QHUH 4XHVWL WHUUHQL QRQ
GHSRVL]LRQH OD GLVWULEX]LRQH H OD GLYHUVD DOWH]]
LGURJUDILFD FKH OL KD GHWHUPLQDWL QRQ SUHVHQWDVV
IRVVH DQFRUD EHQH LPSRVWDWD 3UREDELOPHQWH VL WU
HURVLRQH FDUDWWHUL]]DWH GDOOD SUHVHQ]D GL GHS
HVVHQ]LDOPHQWH ODFXVWUH VL DOWHUQDYDQR HSLVRGL
VXSHUILFLH HURVD GHOOD VHULH PDULQD 3OLRFHQLFR &D
&RQJORPHUDWL GL &DPSRPDULQR 1HOO¶DUHD GVLWRULRQDOH
QHOOD]RQD D 6 GL 8UXUL H VXSHUDQR L P GL TXRWD
JLDOODVWUH FRQ FLRWWRODPH GL PHGLD GLPHQVLRQH
SXOYHUXOHQWR GD TXHVWD]RQD HVVL GHJUDGDQR UDS
6DFFLRQH H GHO))RUWRUH DVVXPHQGR XQ FDUDWWHU
DQGDPHQWR ORQJLWXGLQDOH VSHFLH OXQJR LO YHUVD
FKLDUDPHQWH GHOLPLWDELOL GDJOL DIILRUDPHQWL GHL &

q SUHVHQWH QHOOD¶DUHD VHPLFHQWUDOH GHO WHUULWRU

GHO FDPSR DJULYROWDLFR /¶HWj q DVFULYLELOH DO 3OHL

&RSHUWXUH IOXYLDOL GHO JKLDLH ,/ DLRUSL•QR PLHQRHUHDH]QWD

VDEELRVH VSHVVR ULFRSHUWH GD WHUUH QHUH DG DO

DOOXYLRQDOL LQWHUPHGL KDQQR XQD QDWXUD OLWRORJL

WHUUD]]L DQDORJD q LQIDWWL OD SURYHQLHQ]D GHL FO

PRUIRORJLFD FDUDWWHUL]]DWD GD XQ PDUFDWR IHQRPH

SUHYDOHQWHPHQWH IOXYLDOH SHU TXHVWL GHSRVLWL ,O

HVWHVR OXQJR LO))RUWRUH RYH GD XQD TXRWD GL F

SURJUHVVLYDPHQWH ILQR D IRQGHUVL FRQ L WHUUD]]L SL

GHSRVLWL DOOXYLRQDOL LQGLFDWL FRPH q PROWR SL• PD

FKH LO FRUVR GHJOL DOYHL DWWLYL VL VLD VSRVWDWR JU

'HWWD IRUPD]LRQH DIILRUD QHOOD SDUWH FHQWUDOH GH

FDPSR DJULYROWDLFR /¶HWj q DVFULYLELOH DO 3OHLVWRF

$OOXYLRQL SUHYDOHQWHPHQWH OLPRVH RL DUJLOORVH GHO

VDEELH SURYHQLHQWL HVVHQ]LDOPHQWH GDOO¶HURVLRQH

))RUWRUH D TXHVWR PDWHULDOH ILQH VL LQWHUFDODQ

DSSHQQLQLFD /R VSHVVRUH VXSHUD L PW VROR UDUD

GHOOD IRUPD]LRQH FRVWLWXLWD GD VDEELH ORFDOPHQW

0RQWHVHFFR 4XHVWH DOOXYLRQL WHUUD]]DWH FRVWLWXL

GH PHWUL ULVSHWWR DOO¶DOYHR DWWXDOH $IILRUD QHO

DVFULYLELOH DO 3OHLVWRFHQH VXSHULRUH 2ORFHQH

$OOXYLRQL VRWWRVWDQWL WHUUD]]DWH GD GHSRVLWL FRQ HOHPHQW

VDEELH H DUJLOOH FRQ SUHYDOHQ]D GL GHWULWL ILQL 2

OXQJR LO))RUWRUH /¶HWj q DVFULYLELOH DOO¶2ORFHQH

RVSLWD WHUUHQL DSSDUWHQHQWL DOOH &RSHUWXUH IOXY

GHOOH &RSHUWXUH IOXYLR ODFXVWUL GHL SLDQDOWL H GH

,QROWUH q GD PHWWHUH LQ HYLGHQ]D FRPH OD GLYHUVD

WHUULWRULR VL ULIOHWWH VSHVVR VXOOH IRUPH PRUIRO

YHUVDQWL 4XLQGL D IRUPH PRUIRORJLFKH GROFL FRPH Y

DFFOLYL VL SRVVRQR DVVRFLDUH WHUUHQL WHQHUL P

IRUPD]LRQL FRQJORPHUDWLFKH FHPHQWDWH H IRUPD]LRQL

VSRUJHQ]H H SHQGLL SLXWWRVWR ULSLGL 4XHVWH FRQ

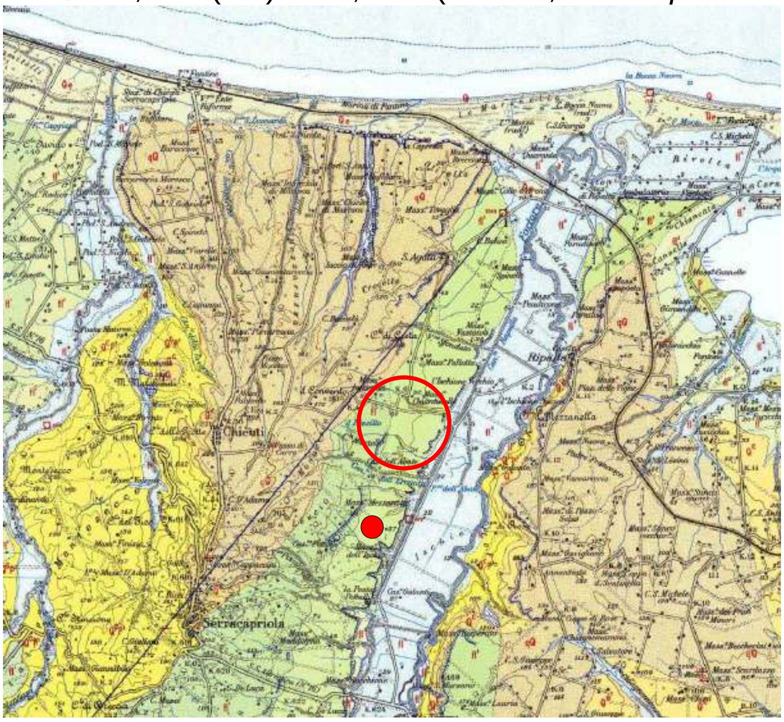
JHQHUDOH HVWHVD LQ WXWWR LO WHUULWRULR SRVWR Q

HVWHQGHUH OD YLVLRQH JHRORJLFD FRPH GHVFULWWR L

FRPSOHWD H JOREDOH GHOOD PRUIRORJLD GHOO¶LGURJHR

DG LQWHUYHQLUH

675$/&,2 '(/)2*/,2 *(2/2*,&2 1ƒ 6 6(9(52



&DPSR DJULYROWDLFR

6WD]LRQH 7HUQD

*KLDLH VDEELH H DUJLOOH GL IRQGRYDOOH DWWXDOL 2O

$OOXYLRQL SUHYDOHQWHPHQWH OLPRVR DUJLOORVH GHO ,

&RSHUWXUH)OXYLR ODFXVWUL GHO ,,ƒ 2UGLQH GHL 7HUUD]

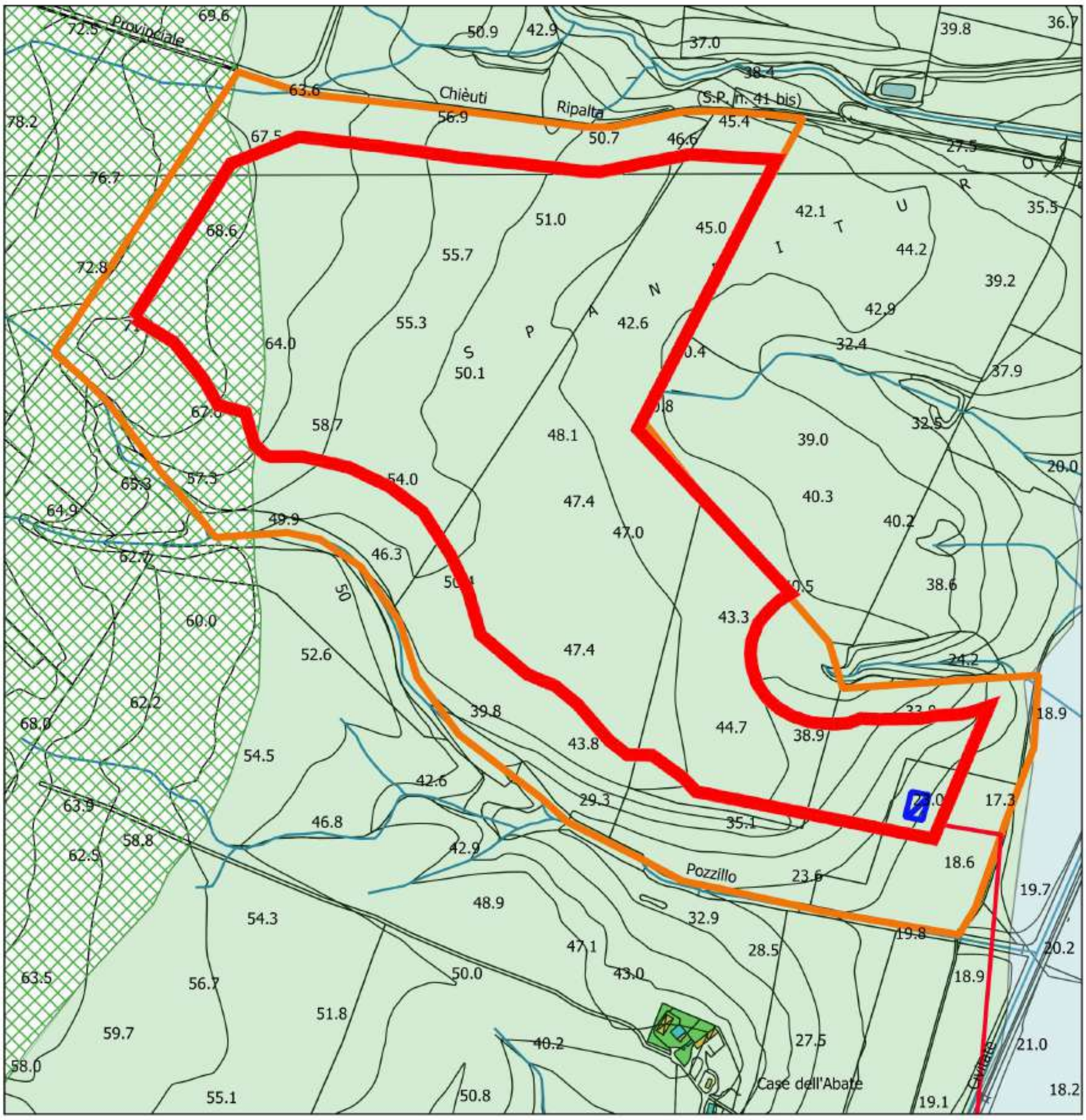
&RSHUWXUH)OXYLR ODFXVWUL GHO ,ƒ 2UGLQH GHL 7HUUD]]L 3O

&RQJORPHUDWL GL &DPSRPDULQR &DODEULDQR 7HUPLQDOH

6DEELH GL 6HUUDFDSULROD 3OLRFHQH 6XSHULRUH &DODEULDQR

$UJLOOH GL 0RQWHVHFFR 3OLRFHQH 0HGLR

6FDOD



CARTA GEOLOGICA IMPIANTO AGRIVOLTAICO

Legenda

- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico
- Cabina MT campo agrivoltaico
- Futura stazione Terna
- Linea Mt

geologia

- Ghiaie, sabbie e argille dei fondovalle attuali (a)
- Alluvioni prevalentemente limoso-argillose del IV Ordine dei Terrazzi
- Coperture Fluviali del II° Ordine dei terrazzi
- Coperture fluviale I° Ordine, ghiaie e sabbie,limi e argille. (Pleistocene).
- Conglomerati di Campomarino. (Calabriano Terminale).
- Sabbie di Serracapriola. (Calabriano-Pliocene Superiore).
- Argille di Montesecco, argilla scistosa, argilla marnosa. (Pliocene)).

Scala 1 : 8.000

(/(0(17, *(2/2*,&2 67587785$/,

/LWRORJLD GHO VXEVWUDWR

3HU TXDQWR ULJXDUGD O¶DVVHWWR OLWRWHFQLFR OR

WHUPLQL ULFRQRVFLXWL LQ DIILRUDPHQWR GD SHFXOLDU

7DY 'L VHJXLWR VRQR GHVFULWWH OH XQLWj OLWRWHF

SL• R PHQR RPRJHQHR

8QLWj OLWRWHFQLFD FRVWLWXLWD GD GHSRVLWL VFL

DUJLOORVL H VDEELRVL ULJXDUGD OD IRUPD]LRQH GHO ,9

VDEELH H DUJLOOH GHL IRQGRYDOOH DWWXDOL 'HWWD XQ

JUDQXODUH HG XQD ULVSRVWD PHFFDQLFD GHO WLSR QRQ

PHGLR

8QLWj OLWRWHFQLFD FRVWLWXLWD GD GHSRVLWL VF

ULJXDUGD OD IRUPD]LRQH GHOOH FRSHUWXUH IOXYLDOL G

OLWRWHFQLFD SUHVHQWD XQ FRPSRUWDPHQWR GHO WLSR

HODVWLFR ,O JUDGR GL SHUPHDELOLWj ULVXOWD LQ JHQH

8QLWj OLWRWHFQLFD D SUHYDOHQWH FRPSRQHQWH VL

GHOOH 6DEELH GL 6HUUDFDSULROD H OD IRUPD]LRQH GH

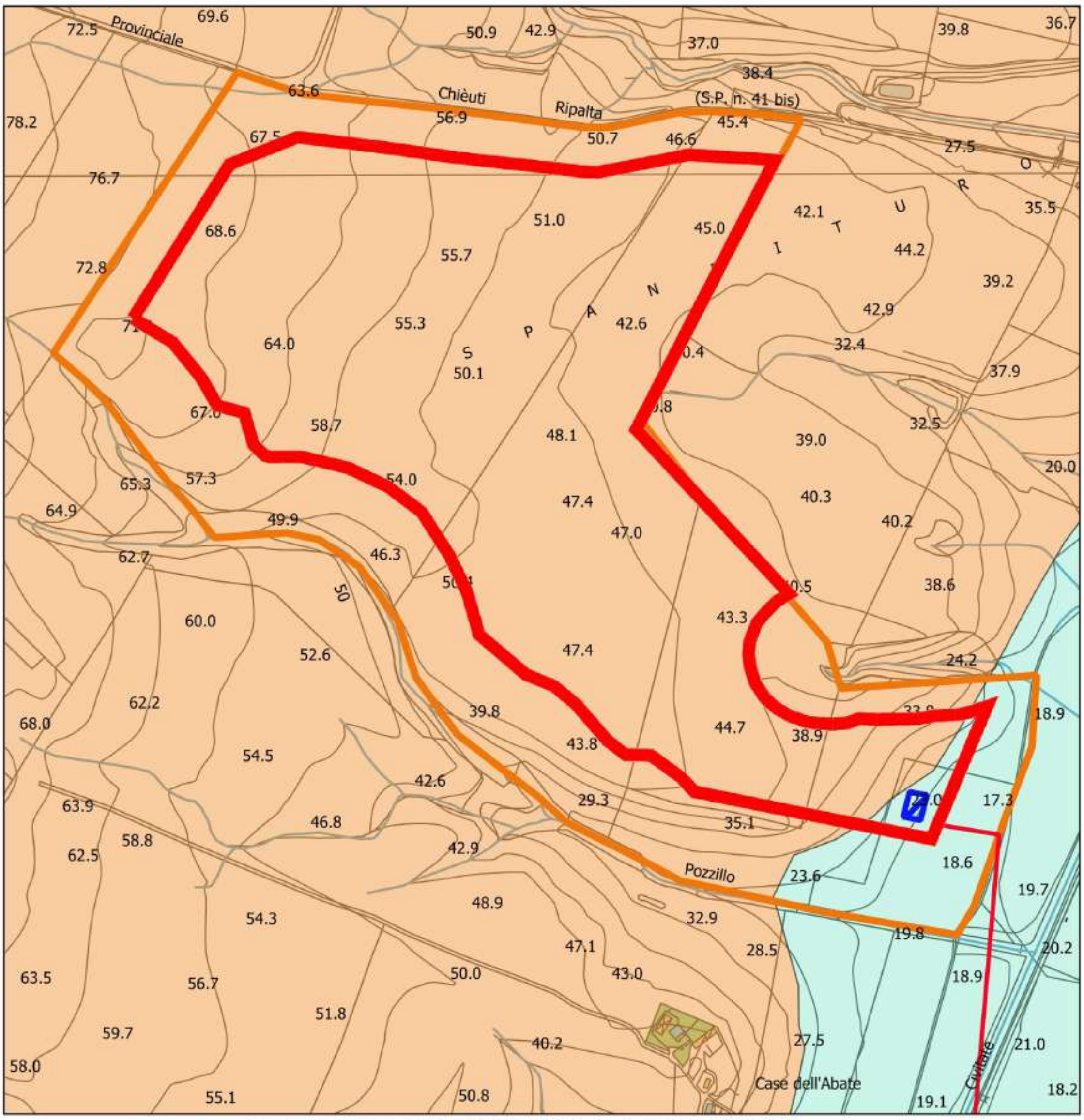
OLWRWHFQLFD SUHVHQWD XQ FRPSRUWDPHQWR GHO WLSR

HODVWLFR ,O JUDGR GL SHUPHDELOLWj ULVXOWD LQ JHQH

8QLWj OLWRWHFQLFD D SUHYDOHQWH FRPSRQHQWH D

0RQWHVHFFR 'HWWD XQLWj OLWRWHFQLFD SUHVHQWD

PHFFDQLFD GHO WLSR QRQ HODVWLFR ,O JUDGR GL SHUP



CARTA LITOLOGICA IMPIANTO AGRIVOLTAICO

Legenda

- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico

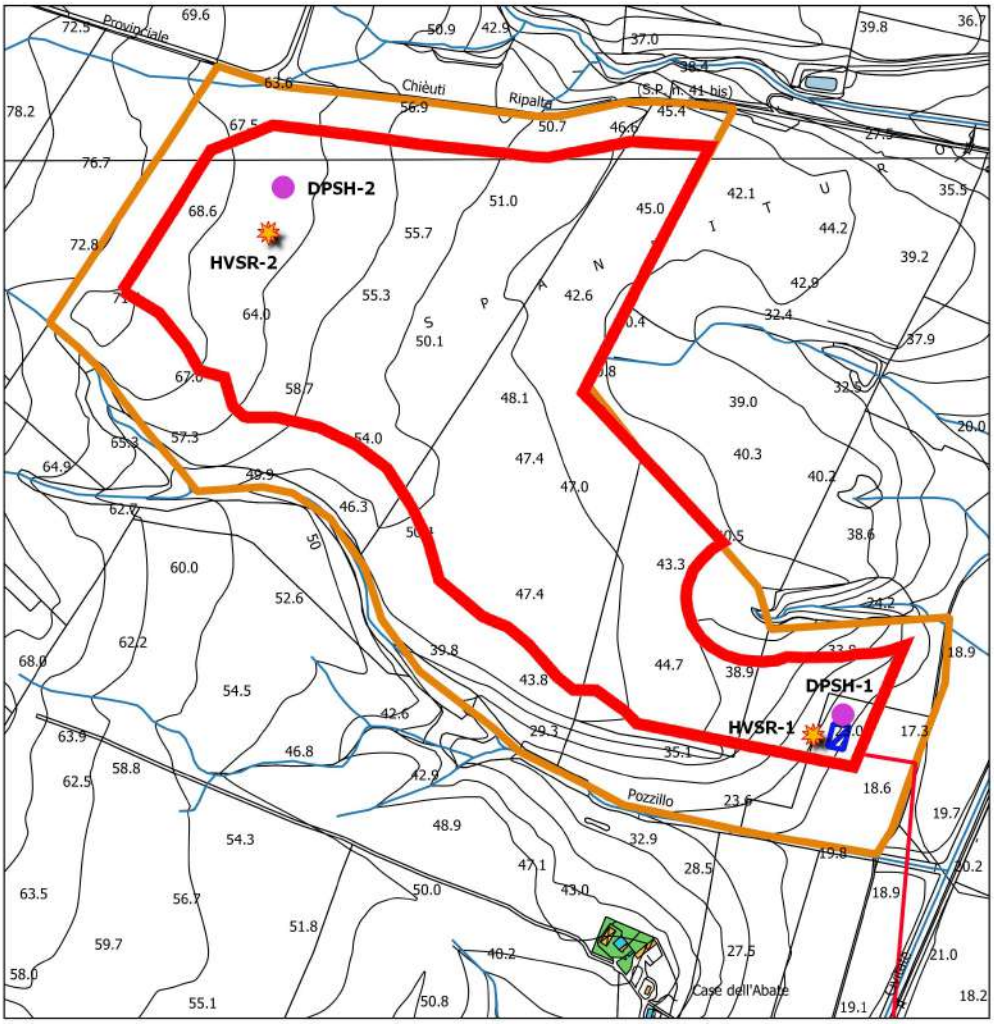
Litologia

- Depositi sciolti a prevalente componente pelitica
- Depositi sciolti a prevalente componente sabbioso-ghiaiosa
- Unit� a prevalente componente argillosa
- Unit� a prevalente componente ruditica
- Unit� a prevalente componente siltoso-sabbiosa e/o arenitica

- Cabina MT campo agrivoltaico
- Futura stazione Terna
- Linea Mt

Scala 1 : 8.000

1HOOH DUHH LQ HVDPH FRPH JLj GHVFULWWR q VWDW
FRVWLWXLWD GD GXH SURYH SHQHWURPHWULFKH GHO WLS
VLJQLILFDWLYD ULILXWR H GXH SURYH GL VLVPLFD SDVV
ORFDOH DL VHQVL GHO ' 0 H GHOOD &LUFRODUH G
VWDWH HIIHWWXDWH GXH SURYH VLVPLFKH GHO WLSR SDVV



PLANIMETRIA UBICAZIONE INDAGINI GEOGNOSTICHE IMPIANTO AGRIVOLTAICO

Legenda

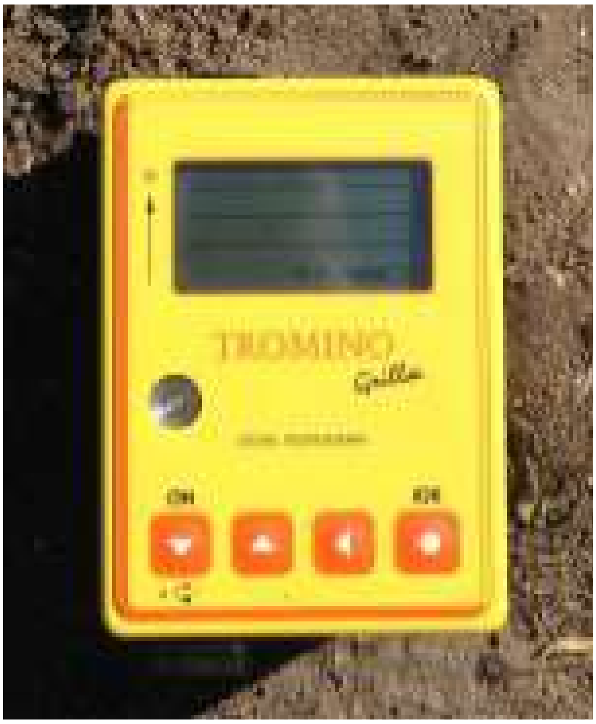
- Area a disposizione per campo agrivoltaico
- Campo agrivoltaico
- Cabina MT campo agrivoltaico
- Sottostazione Terna
- DPSH
- Prova sismica HVSR

Scala 1 : 8.000

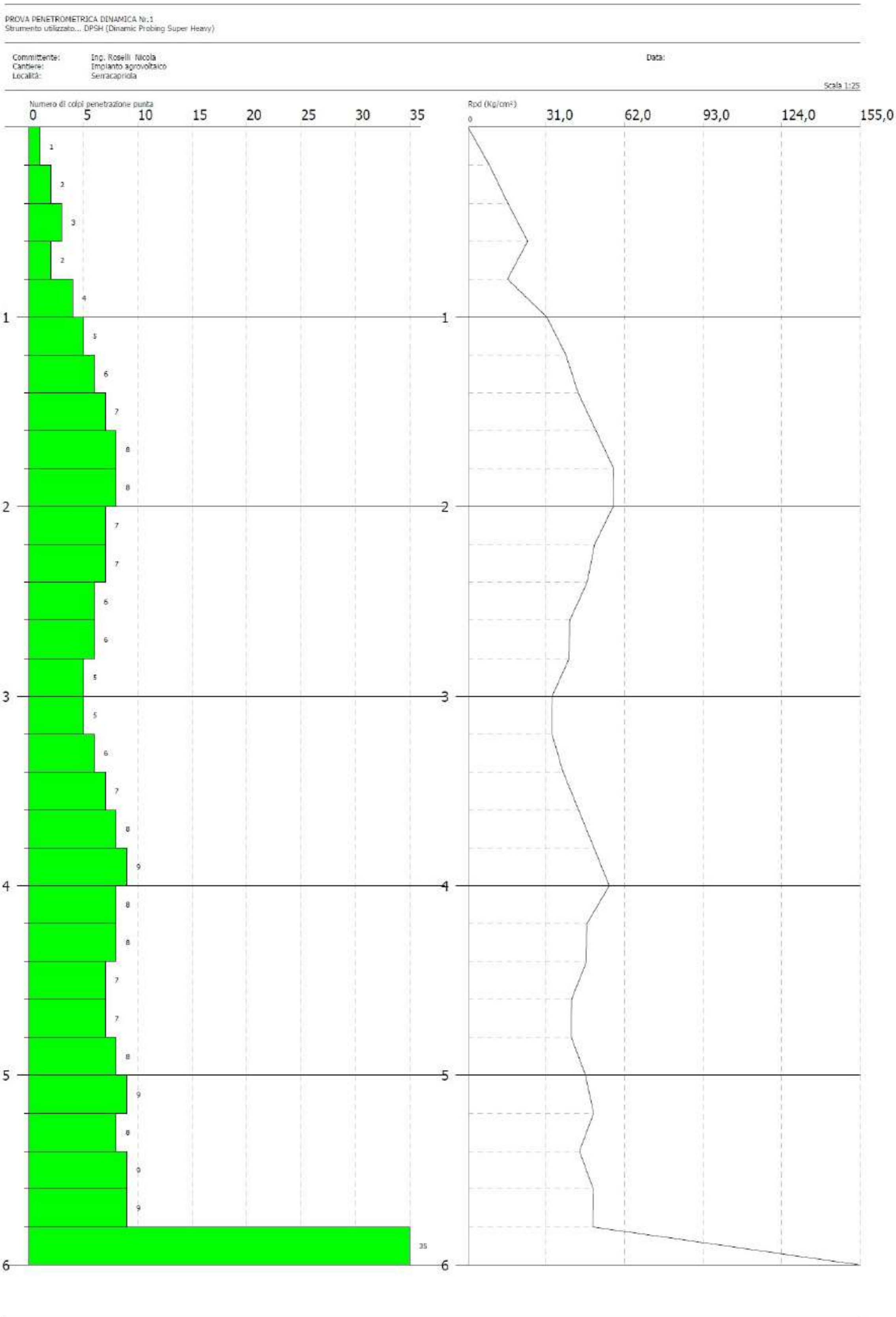
WŒ}À ‰ v šŒ}u šŒ]]v u] }vš]vµ W^,

WŒ}À ‰ v šŒ}u šŒ]]v u] }vš]vµ

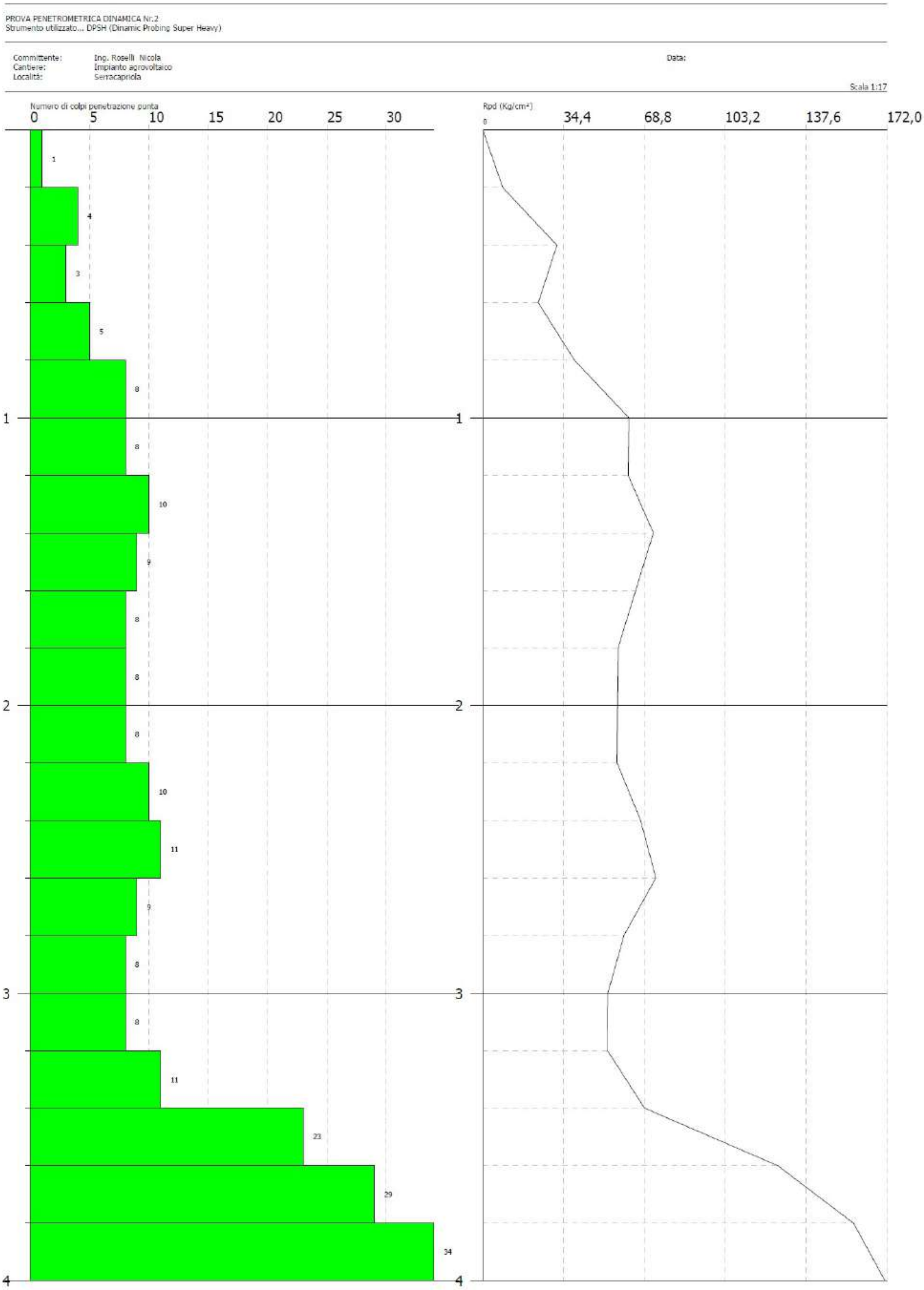
d Œ } u] v } • š Œ µ u v š } P } ( ] •] } ‰ Œ ‰ Œ } À •



3529$ 3(1(7520(75,&$ '36+



3529$ 3(1(7520(75,&$ '36+



02'(//2 *(2/2*,&2 &$032 $*5,927$,&2 '36+

PW 7HUUHQR YHJHWDOH OLPRVR VDEELRVR FRQ

PW 6DEELH OLPRVH FRQ UDUH LQFOXVLRQL JK

PW 6DEELH OLPRVH FRQ LQFOXVLRQL JKLDLR

PW 6DEELH FRQ JKLDLH D OXRJKL OLPRVH

&$5$77(5,==$=,21(*(27(&1,&$ 3529$ 3(1(7520(75,&$ '36+

–"ƒ–'	"'^ä •	–"ƒ–' •'–	" ..	M •‰'Ž' †ïƒ––"‹–' ‹•–‡"•' ₁	‡† •'†—Ž' ‡†'•‡–"‹… ‰ .!. •	Žƒ••‹^‹…ƒœ‹'•‡	J ‡•' †‹ Ž—•‡ –‡""‡•' – ↵	J™ ‡•' †‹ Ž—•‡ –‡""‡•' •ƒ––"' – ↵	ï ‡^^‹…‹‡•–‡ '‹—••'•	•'†—Ž' †‹ –ƒ‰Ž‹' †‹•ƒ•‹…' ‰ .!. •
sæ	rärræsärr	uäxs	syäru	ttäux	•…‹uŽ–äzz	sävz	säzz	räuw	tsyätx
t	särr uäxr	{äx	utäs	ty	vyäts '…' ž••ƒ–'	säyt	sä{t	räuv	wvväzs
u	uäxræwäzr	stäu	uyäzw	tzäwz	'†‡"ƒ–ƒ•‡•–‡ ƒ†††‡••ƒ–' wtäyu	sä{u	sä{u	räuu	xzyäyv
v	wäzræxärr	wtäxv	ztäxw	vuäs	'Ž–' ƒ†††‡••ƒ–' suwäw{	täwr	täwr	rätw	tx{yävu

&$5$77(5,==$=,21(*(27(&1,&$ 3529$ 3(1(7520(75,&$ '36+

–"ƒ–'	"'^ä •	–"ƒ–' •'–	" ..	M •‰'Ž' †ïƒ––"‹–' ‹•–‡"•' ₁	‡† •'†—Ž' ‡†'•‡–"‹… ‰ .!. •	Žƒ••‹^‹…ƒœ‹'•‡	J ‡•' †‹ Ž—•‡ –‡""‡•' – ↵	J™ ‡•' †‹ Ž—•‡ –‡""‡•' •ƒ––"' – ↵	ï ‡^^‹…‹‡•–‡ '‹—••'•	•'†—Ž' †‹ –ƒ‰Ž‹' †‹•ƒ•‹…' ‰ .!. •
sæ	rärrærázr	väz{	träwv	tuäwx	'…' ƒ†††‡••ƒ–' uräst	säwu	sáz{	räuv	tzzä{z
t	räzr uävr	suävt	vrärx	t{äs{	'†‡"ƒ–ƒ•‡•–‡ ƒ†††‡••ƒ–' srtyäux	säzv	sá{v	räuu	yvxävw
u	uävræuäzr	u{äs	ysäxv	u{ätt	††‡••ƒ–' ustäzr	tätr	táwr	rätz	tru{äxy
v	uäzræväzr	wsäsv	zsäuu	vtäy	'Ž–' ƒ†††‡••ƒ–' vr{äst	tätv	táwr	rätw	txtwäst

'DOO¶DQDOLVL GHOOH SURYH VL HYLQFH FKH WXWWL JOL V

3HU TXDQWR ULJXDUGD OH SURYH VLVPLFKH D ULIOHVVLR

PLVXUH VRQR VWDWH HIIHWWXDWH SHU PH]]R GL XQ

VSHFLILFDWDPHQWH SHU O DFTXLVL]LRQH GHL GDWL VLVPLFL

[[FP SHU .J GL SHVR GL WUH VHQVRUL HOHWWURGL

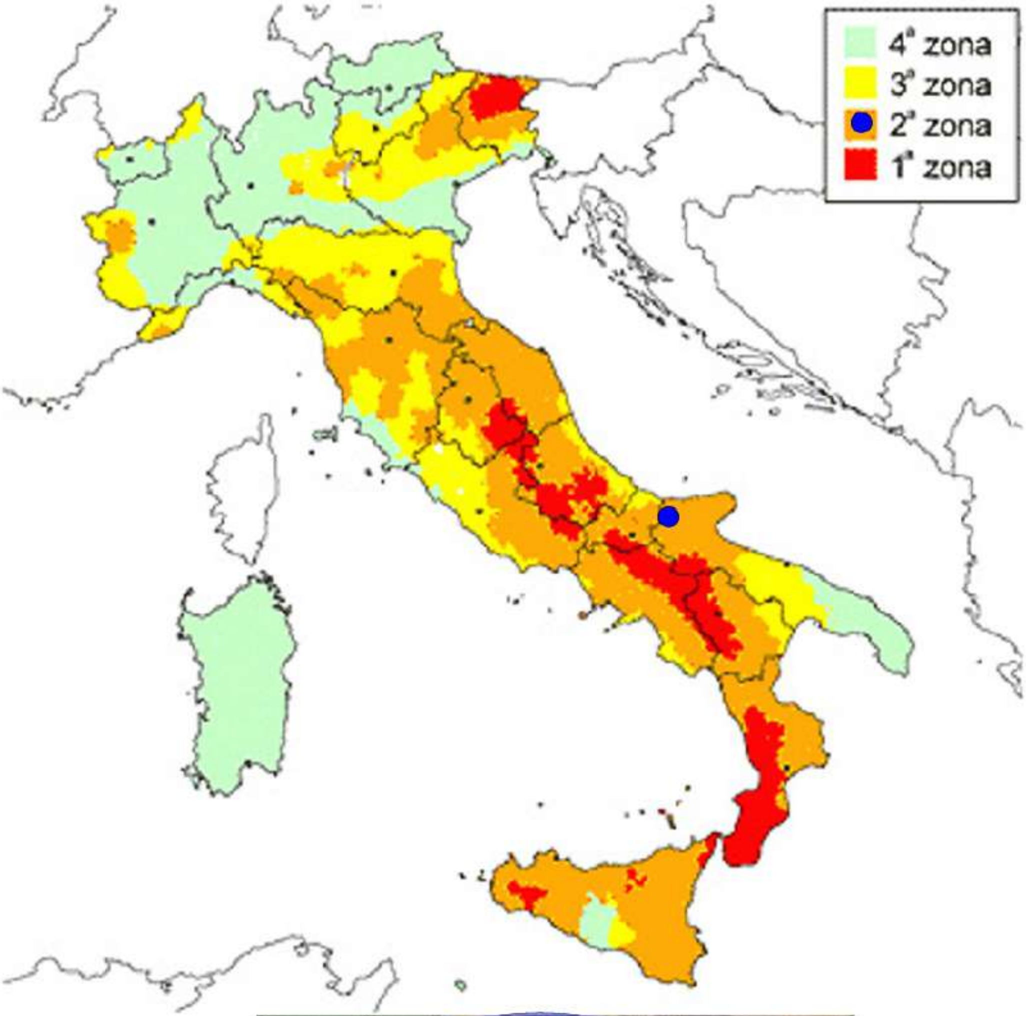
: H YHUWLFDOPHQWH DOLPHQWDWR GD EDWWHULH $$ G

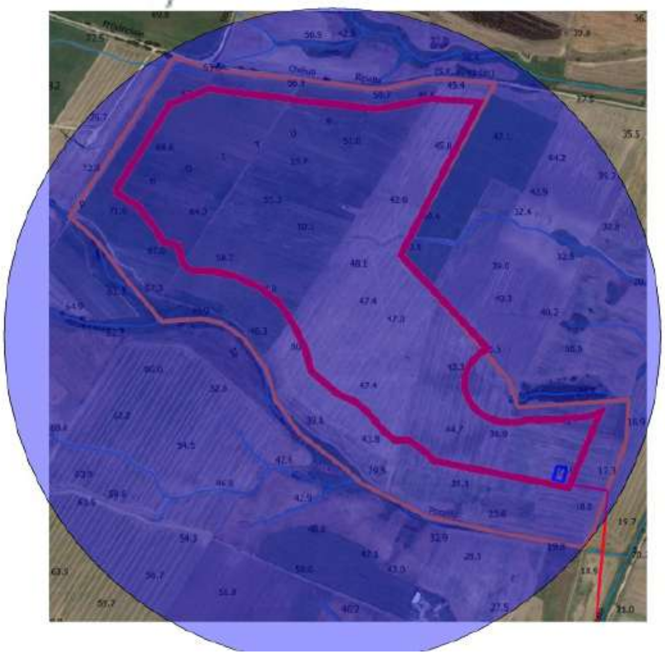
DPSOLILFDWL H GLJLWDOL]]DWL D ELW HTXLYDOHQWL V

GL +] LQ PRGR GD DYHUH LQIRUPD]LRQL VX IUHTXHQ]H
GL 1\TXLVW VHFRQGR LO TXDOH OD PDVVLPD IUHTXHQ]D
IUHTXHQ]D GL FDPSLRQDPHQWR GHO VHJQDOH VWHVVR
,O ULVXOWDWR ILQDOH FRQVLVWH QHOOD JUDILFL]]D]LRQ
QHOO LQWHUSUHWD]LRQH VHFRQGR OD WHFQLFD GL 1DNDP
WHUUHQR GL IRQGD]LRQH ,QROWUH O¶HODERUD]LRQH GH
SHUPHVVR OD FODVVLILFD]LRQH GHO WLSR GL WHUUHQR
&LUFRODUH GHO & 6 // 33 Q GHO JHQQDLR 'DL ULV
HYLQFH FKH LO FDPSR DJULYROWDLFR SUHVHQWD XQD YH
9VBHTX GL P VHF FKH LQGLYLGXD XQD WHUUD WLSR
O¶DVVHQ]D GL IDOGD LGULFD

5(/$=,21(68//$ 3(5,&2/26,7$¶ 6,60,&

$L VHQVL GHO ' 0 H GHOOD &LUFRODUH GHO & 6


4ª zona
3ª zona
2ª zona
1ª zona



9$/87$=,21('(//$ 3(5,&2/26,7$¶ 6,60,&$ '(//¶$5($ $//2 678',2

3UHPHVVR FKH SHU SHULFRORVLWj VLVPLFD GL XQ¶DU WHPSR SXz YHULILFDUVL XQ WHUUHPRWR GL XQD FHUWD JHRORJLD GHO VLWR PRUIRORJLD VXSHUILFLDOH PRUIRO SURIRQGLWj GHOOD IDOGD IUHDWLFD FRVWLWX]LRQH H SU GLSHQGH GDOOH SDUWLFRODUL FRQGL]LRQL ORFDOL FLRq GHSRVLWL GL WHUUHQR GHJOL DPPDVVL URFFLRVL H GDO OR FRVWLWXLVFRQR

&Lz SUHPHVVR LO WHUULWRULR FRPXQDOH GL 6HUU ' 0 / 2UGLQDQ]D 3 & 0 Q GHO ULFODVV H LQ WDOH TXDGUR LO WHUULWRULR GL 6HUUDFDSULROD Y 6L ULSRUWD OD WDEHOOD RYH FLDVFXQD]RQD q LQGLYL RUL]]RQWDOH GHO VXROR DJ FRQ SUREDELOLWj GL VXSHU

		1250$7,9$ 35(&('(17(		1250$7,9$ 778/(
=RQH 6LVPLFKH	&ODVVH 6	&RHIILFLHQWH 6LVPLFR & 6	$PSOLILFD]LRQH VLVPLFD	$PSOLILFD]LRQH VLVPLFD D J
	(OHYDWD 6LVPLFLWj			
	0HGLD 6LVPLFLWj			
	0RGHUDWD 6LVPLFLWj			
	%DVVD 6LVPLFLWj			

&RQ O HQWUDWD LQ YLJRUH GHO ' 0 JHQQDLR GHILQLWD PHGLDQWH XQ DSSURFFLR ³VLWR GLSHQGHQWH´ /¶D]LRQH VLVPLFD GL SURJHWWR LQ EDVH DOOD TXDOH YD VL GHILQLVFRQR D SDUWLUH GDOOD ³SHULFRORVLWj VLVPL GHOOH FDUDWWHULVWLFKH PRUIRORJLFKH H VWUDWLJUDILF DOOD VFDOD GHOOD VLQJROD RSHUD R GHO VLQJROR VLVWH FRPH ULVSRVWD VLVPLFD ORFDOH /D VWHVVD FRQVHQWH

VXELVFH D FDXVD GHL IDWWRUL DQ]L GHWWL ULVSHWWR

$ FRQ VXSHUILFLH WRSRJUDILFD RUL]]RQWDOH FDWHJRUL

,Q GHILQLWLYD OD ULVSRVWD VLVPLFD ORFDOH q O¶D]LR

GHOOH PRGLILFKH LQ DPSLH]]D GXUDWD FRQWHQXWR LQ

ULJLGR FODVVLILFD]LRQH GHO VRWWRVXROR VL HIIHWWXD L

GHOOD YHORFLWj HTXLYDOHQWH GL LQ URSV DJD]LRQH GHOOH

$$V_{S,eq} = \frac{H}{\sum_{i=1}^{N} \frac{h_i}{V_{S,i}}}$$

FRQ
KL VSHVVRUH GHOOR VWDWR L VHVLPR
9V L YHORFLWj GHOOH RQGH GL WDJOLR QHOO¶L HVLPR V
1 QXPHUR GL VWUDWL
+ SURIRQGLWj GHO VXEVWUDWR GHILQLWR FRPH TXHOOD
ULJLGR FDUDWWHUL]]DWD GD 9V QRQ LQIHULRUH D P V

'DL ULVXOWDWL GHOOH YHORFLWj GHOOH RQGH GL WDJOL

YHORFLWj PLQLPD 9VBHTX GL P VHF PDVVLPD 9VBHTX G

WL%R

3HU OH IRQGD]LRQL VXSHUILFLDOL OD SURIRQGLWj GHO

VWHVVH PHQWUH SHU OH IRQGD]LRQL VX SDOL DOOD WHVW

1HO FDVR GL RSHUH GL VRVWHJQR GL WHUUHQL QDWXU

PXUL GL VRVWHJQR GL WHUUDSLHQL OD SURIRQGLWj YLH

3HU GHSRVLWL FRQ SURIRQGLWj + GHO VXEVWUDWR VXSHU

WDJOLR 96 HT q GHILQLWD GDO SDUDPHWUR 96 RWW

HVSUHVVLRQH H FRQVLGHUDQGR OH SURSULHWj GHJOL VWU

9HQJRQR LGHQWLILFDWH FODVVL $ % & ' H (DG

ULVSRVWD HODVWLFR /R VFKHPD LQGLFDWLYR GL ULIHULP

VHJXHQWH

&OD	'HVFUL]LRQH
$	$PPDVVL URFFLRVL DIILRUDQWL R WHUUHQL PR YDORUL GL YHORFLWj GHOOH RQGH GL WDJO HYHQWXDOPHQWH FRPSUHQGHQWL LQ VXSHUILF PHFFDQLFKH SL• VFDGHQWL FRQ VSHVVRUH PDV
%	5RFFH WHQHUH H GHSRVLWL GL WHUUHQL D JU WHUUHQL D JUDQD ILQH PROWR FRQVLVWHQW PLJOLRUDPHQWR GHOOH SURSULHWj PHFFDQLF YDORUL GL YHORFLWj HTXLYDOHQWH FRPSUHVL
&	'HSRVLWL GL WHUUHQL D JUDQD JURVVD PHGLD JUDQD ILQH PHGLDPHQWH FRQVLVWHQWL FRQ VXSHULRUL D P FDUDWWHUL]]DWL GD XQ PLJ PHFFDQLFKH FRQ OD SURIRQGLWj H GD YDORUL FRPSUHVL WUD P V H P V
'	'HSRVLWL GL WHUUHQL D JUDQD JURVVD VFDU WHUUHQL D JUDQD ILQH VFDUVDPHQWH FRQVL VXEVWUDWR VXSHULRUL D P FDUDWWHUL]]DW SURSULHWj PHFFDQLFKH FRQ OD SURIRQGLWj HTXLYDOHQWH FRPSUHVL WUD H P V
(	7HUUHQL FRQ FDUDWWHULVWLFKH H YDORUL ULFRQGXFLELOL D TXHOOH GHILQLWH SHU OH SURIRQGLWj GHO VXEVWUDWR QRQ VXSHULRUH

3HU TXDOVLDVL FRQGL]LRQH GL VRWWRVXROR QRQ FODVV

SUHGLVSRUUH VSHFLILFKH DQDOLVL GL ULVSRVWD ORFDOH

'HWHUPLQD]LRQH GHL SDUDPHWUL VLVPLFL

,PSLDQWR DJULYROWDLFR ƒ ¶ ¶¶1 ƒ ¶ ¶¶(

&DWHJRULD %VRWWRVXROR

&DWHJRULD WRSRJUDILFD 7

$PSOLILFD]LRQH WRSRJUDILFD 6W

9(5,),&+(*(27(&1,&+(17&

&$5$77(5,==$=,21((02'(//$=,21(*(2/2*,&$ '(/ 6,72

,O PRGHOOR JHRORJLFR GL ULIHULPHQWR q OD ULFRVWUX]
VWXGLR DWWUDYHUVR OD GHVFUL]LRQH GHOOH SHFXOLD
GLQDPLFKH GHL GLYHUVL WHUPLQL OLWRORJLFL GHL UDS
WHWWRQLFKH VXELWH H GHOO¶D]LRQH GHL GLYHUVL DJHQW

,1'$*,1, &$5$77(5,==$=,21((02'(//$=,21(*(27(&1,&$

/H LQGDJLQL JHRWHFQLFKH GHYRQR HVVHUH SURJUDPPDWH
GHYRQR ULJXDUVLD O¶HIIHWWR VXOO DPH LQ SUHVHQ]D GL D]LRQL
D TXDQWR SUHVFULWWR DL †† GHL WHUUHQR YROXPH
VRWWRVXROR LQIOXHQ]DWD GLUHWWDPHQWH R LQGLUHW
LQIOXHQ]D LO PDQXIDWWR VWHVVR

&$5$77(5,==$=,21(*(27(&1,&$ $,),1, 6,60,&,

/H LQGDJLQL JHRWHFQLFKH GHYRQR HVVHUH SUHGLVSRV
JHRORJLFR DGHJXDWDPHQWH GHILQLWR FKH FRPSUHQGD L
O¶HYHQWXDOH SUHHVLVWHQ]D GL IHQRPHQL GL LQVWDELO
O¶DFFHUWDPHQWR GHJOL HOHPHQWL FKH XQLWDPHQWH D
GHOOH RQGH VLVPLFKH TXDOL OH FRQGL]LRQL VWUDWLJU
IRUPD]LRQH DG HVVR DVVLPLODELOH

5,63267$ 6,60,&$ (67$%,/,7¬ '(/ 6,72

5,63267$ 6,60,&$ /2&$/(

,O PRWR JHQHUDWR GD XQ WHUUHPRWR LQ XQ VLWR GLSH
FDUDWWHULVWLFKH WRSRJUDILFKH H VWUDWLJUDILFKH GH
WHUUHQL H GHJOL DPPDVVL URFFLRVL GL FXL q FRVWLWX
VLVWHPD JHRWHFQLFR O¶DQDOLVL GHOOD ULVSRVWD VLV
FKH LO VHJQDOH VLVPLFR GL LQJUHVVR VXELVFH D FDXVD

)$7725, ', $03/,),&$=,21(675$7,*5$),&$

)$7725, ', $03/,),&$=,21(7232*5$),&$

,Q FRQGL]LRQL VWUDWLJUDILFKH H PRUIRORJLFKH VFKHPD
SHU SURILOL VWUDWLJUDILFL ULFRQGXFLELOL DOOH FDW
VXSHUILFLH GL XQ VLWR q GHILQLELOH PHGLDQWH O¶DFFH
XQD IRUPD VSHWWUDOH DQFRUDWD DG HVVD ,O YDORUH G
66 [DJ GRYH DJ q O¶DFFHOHUD]LRQH PDVVLPD VX VLWR UL
DPSOLILFD]LRQH VWUDWLJUDILFD

67$%,/,7¬ 1(, &21)5217, '(//$ /,48()$=,21(

*HQHUDOLWj

,O VLWR SUHVVR LO TXDOH q XELFDWR LO PDQXIDWWR GH
LQWHQGHQGR FRQ WDOH WHUPLQH TXHL IHQRPHQL DVVR
DFFXPXOR GL GHIRUPD]LRQL SODVWLFKH LQ WHUUHQL VDW
FLFOLFKH H GLQDPLFKH FKH DJLVFRQR LQ FRQGL]LRQL QR
OLTXHID]LRQH H JOL HIIHWWL FRQVHJXHQWL DSSDLRQR WD
PDQXIDWWL RFFRUUH SURFHGHUH DG LQWHUYHQWL GL FR
VWUDWL GL WHUUHQR QRQ VXVFHWWLELOL GL OLTXHID]LRQ

(VFOXVLRQH GHOOD YHULILFD D OLTXHID]LRQH

/D YHULILFD D OLTXHID]LRQH SXz HVVHUH RPHVVD TXDQGR
FLUFRVWDQ]H

DFFHOHUD]LRQL PDVVLPH DWWHVH DO SLDQR FDPSDJQD
OLEHUR PLQRUL GL

SURIRQGLWj PHGLD VWDJLRQDOH GHOOD IDOGD VXSHULRU
FDPSDJQD VXE RUL]]RQWDOH H VWUXWWXUH FRQ IRQGD]LRQ

GHSRVLWL FRVWLWXLWL GD VDEELH SXOLWH FRQ UHVLVWH
RSSXUH TF1 ! GRYH q LO YDORUH GHOOD UHVLVWHQ]D GHWHU
GLQDPLFKH 6WDQGDUG 3HQHWUDWLRQ 7HVW QRUPDOL]]DV
TF 1 q LO YDORUH GHOOD UHVLVWHQ]D GHWHUPLQDWD LQ S
7HVW QRUPDOL]]DWD DG XQD WHQVLRQH HIILFDFH YHUWLF

GLVWULEX]LRQH JUDQXORPHWULFD HVWHUQD DOOH]RQH
FRHIILFLHQWH 8F GL XQLIRUPLWj E QHO FDVR GL WHUUH
XQLIRUPLWj

9(5,),&+(', 6,&85(==$

/H YHULILFKH GL VLFXUH]]D UHODWLYH DJOL VWDWL OLPLW
HVHUFL]LR 6/(GHYRQR HVVHUH HIIHWWXDWH QHO ULVSHW
†

9(5,),&+(1(, &21)5217, '(*/, 67$7, /,0,7(8/7,0, 6/8

3HU RJQL VWDWR OLPLWH SHU SHUGLWD GL HTXLOLEULR (
OD FRQGL]LRQH (G ≤ 5G GRYH (G q LO YDORUH GL SURJHWWR GHOO¶D
LO YDORUH GL SURJHWWR GHOO¶D]LRQH R GHOO¶HIIHWWR GHOO¶D]LRQH YHULILFD GHOOD VX
HVHJXLWD LPSLHJDQGR FRPELQD]LRQL GL FRHIILFLHQWL SDU]LDOL SHU WD
WDEHOOD , 3HU RJQL VWDWR OLPLWH XOWLPR GHYH HVVHUH ULVSHWWDWD OD FRQGL]LRQH

HOHPHQWR VWUXWWXUDOH 675 R GHO GWHYHUUHHQVRHU*H(2ULVFSRH

FRQGL]LGRQHHG >HVV@QGR (G LO YDORUH GL SURJHWWR GHO

GHILQLWR GDOOH UHOD]LRQL

$$E_d = E\left[\gamma_F F_k; \frac{X_k}{\gamma_M}; a_d\right] \quad [6.2.2a]$$

$$E_d = \gamma_E \cdot E\left[F_k; \frac{X_k}{\gamma_M}; a_d\right] \quad [6.2.2b]$$

H 5G q LO YDORUH GL SURJHWWR GHOOD UHVLVWHQ]D GHO

$$R_d = \frac{1}{\gamma_R} R\left[\gamma_F F_k; \frac{X_k}{\gamma_M}; a_d\right] \quad [6.2.3]$$

(IIHWWR GHOOH D]LRQL H UHVLVWHQ]D GL SURJHWWR VRQR

XQ]LRQH GHOOH D]L)NRQGLHGLG SDUUDRPJHHWWUWLR JHHRVWHFQLFL SGDLUDP

JHRPHWULFL GG LOSFURHJHHWWLRQDWH SDU]LDOH GL VLFXUH]]D R

VLVWHPD /¶HIIHWWR GH5OOD DQFKH L GLVSRUJHWWR D WR G

FDUDWWHULVWLFL GHOOH D]LRQL FRQH DQFRUFKDWR GXDQW

† OD YHULILFD GHOOD FRQGL]LRQH > @ GHYH HVVH

GL JUXSSL GL FRHIILFLHQWL SDU]LDOL ULVSHWWLYDPHQW

JHRWHFQLFL 0 H 0 H SHU OH UHVLVWHQ]H 5 5 H 5

SDU]LDOL VRQR VFHOWL QHOO¶DPELWR GL GXH DSSURFFL

SURJHWWXDOH $SSURFFLR OH YHULILFKH VL HVHJXRQ

FRHIILFLHQWL RJQXQD GHOOH TXDOL SXz HVVHUH FULWLF

VHFRQGR DSSURFFLR SURJHWWXDOH $SSURFFLR OH YHU

JUXSSL GL FRHIILFLHQWL 3HU OH YHULILFKH QHL FRQIURQ

QHL VXFFHVVLYL SDUDJUDIL GD D VL XWLOL]]D

$ 0 5 H $ 0 5 , IDWWRUL SDU]LDOL SHU LO JUXSSR

JUXSSR 5 SRVVRQR HVVHUH PDJJLRUL R XJXDOL DOO XQLW

VWDWR OLPLWH XOWLPR FRQVLGHUDWR GHYRQR HVVHUH

FRQQHVVH FRQ L SURFHGLPHQWL DGRWWDWL

$=,21,

, FRHIILFLHQWLLHOSDU]LDOL DOOH D]LRQL VRQR LQGLFDWL QH

HVVHUH IDWWR ULIHULPHQWR FRQ OH SUHFLVD]LRQL ULSR

WHUUHQR H O¶DFTXD FRVWLWXLVFRQR FDULFKL SHUPDQ

XWLOL]]DWD FRQWULEXLVFRQR DO FRPSRUWDPHQWR GHOO

H ULJLGH]]D 1HOOD YDOXWD]LRQH GHOOD FRPELQD]LRQH

GHYRQR HVVHUH DVVXQWL FRPH VSHFLILFDWR QHO &DSLWR

5(6,67(1=$

,O YDORUH GL SURJHWWR GHOOD UHVLVWHQ]D 5G SXz HVVH

D LQ PRGR DQDOLWLFR FRQ ULIHULPHQWR DO YDORUH F

GLYLVR SHU LO YDORUH 0G VSHFLILFDWR QHO FDSLWROR ...

FRQWR RYH QHFHVVDULR5 VSHFLILFDWR QHOOH SDUWLFRODUL

RSHUD

E LQ PRGR DQDOLWLFR FRQ ULIHULPHQWR D FRUUHOD]LR

FRHIILFLHQWL5 SDU]LDOL ULSRUWDWL QHOOH WDEHOOH FRQWHQXWH QH

F VXOOD EDVH GL PLVXUH GLUHWWH VX SURWRWLSL5 ...

WDEHOOH FRQWHQXWH QHL SDUDJUDIL UHODWLYL D FLDVFX

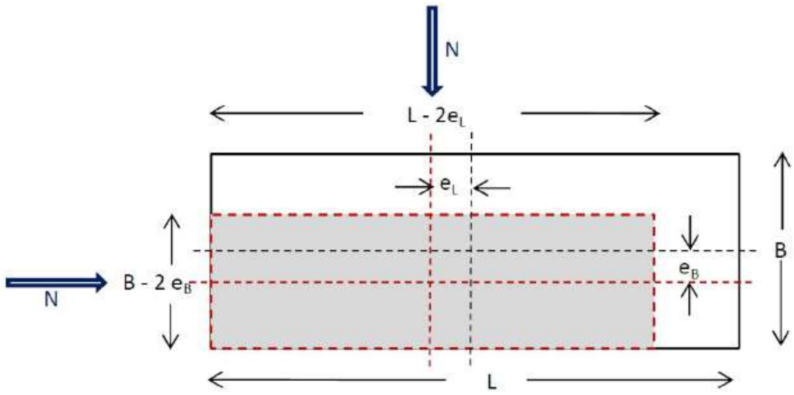
'DOOH LQGDJLQL JHRWHFQLFKH H VLVPLFKH HIIHWWXDWH

JHRWHFQLFL PLQLPL XWLOL]]DQGR XQ IRJOLR GL FDOFRO

WXWWH OH LQGDJLQL QRQ VL q ULVFRQWUDWD OD SUHVHQ]

CALCOLO CAPACITA' PORTANTE FONDAZIONI SUPERFICIALI (NTC 2018)

La fondazione è la parte di una struttura che serve a trasmettere il carico dell'opera al terreno sottostante attraverso la superficie di contatto (piano di posa). In accordo con la teoria di Terzaghi, una fondazione si definisce di tipo superficiale se D/B < 4, essendo D la profondità del piano di posa rispetto al piano di campagna e B la dimensione minima in pianta della fondazione.



Carichi permanenti	G_{k1} =	250	KN
Carichi permanenti non strutturali	G_{k2} =	130	KN
Sovraccarichi	Q_k =	0	KN
Risultante dei carichi verticali	N =	380	KN
Inclinazione della risultante N rispetto alla verticale	θ =	0	°
Componente orizzontale dei carichi agente sul piano di posa	H =	0.00	KN
Componente verticale dei carichi agente sul piano di posa	V =	380.00	KN
Eccentricità della risultante dei carichi parallela al lato B	e_B =	0.00	m
Eccentricità della risultante dei carichi parallela al lato L	e_L =	0.00	m
Largezza della fondazione all'appoggio sul terreno	B =	4.40	m
Lunghezza della fondazione	L =	15.00	m
Profondità del piano di posa della fondazione	D =	1.00	m
Largezza ridotta della fondazione per eccentricità del carico	B' =	4.40	m
Lunghezza ridotta della fondazione per eccentricità del carico	L' =	15.00	m
Coesione del terreno al di sotto del piano di posa	c =	0.00	KN/m^2
Adesione lungo la base della fondazione (ca < c)	c_a =	0.00	KN/m^2
Angolo di attrito del terreno al di sotto del piano di posa	ϕ =	27	°
Pressione geostatica sul piano di posa della fondazione	q =	17.2	KN/m^2
Peso unità di volume del terreno al di sotto del piano di posa	γ_t =	17.20	KN/m^3
Angolo di inclinazione del piano di campagna	ω =	3	°
Angolo di inclinazione del piano di posa	ε =	0	°

Parametri sismici

Stato limite considerato			SLV	
Accelerazione orizzontale massima attesa sul sito di riferimento		a_g =	0.159638	m/sec^2
Fattore di amplificazione spettrale max sul sito di riferimento		F_o =	2.582232	
Categoria di sottosuolo	B	β_s =	0.24	
Coefficiente di amplificazione stratigrafica		S_s =	1.20	
Categoria topografica	T1	S_T =	1.0	

Calcolo capacità portante fondazioni superficiali

pag. 1

Il carico limite unitario del terreno di fondazione, calcolato con la formula di Brinch - Hansen, è dato dalla seguente espressione:

$$q_{lim} = c \cdot N_c \cdot s_c \cdot d_c \cdot i_c \cdot g_c \cdot b_c \cdot z_c + q \cdot N_q \cdot s_q \cdot d_q \cdot i_q \cdot g_q \cdot b_q \cdot z_q + 0{,}5 \cdot B \cdot \gamma_t \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma \cdot i_\gamma \cdot g_\gamma \cdot b_\gamma \cdot z_\gamma \cdot e_{\gamma k} \cdot e_{\gamma i}$$

Fattori di capacità portante N_c, N_q e N_γ

per c > 0 e $\phi = 0$	
$N_c = 2 + \pi$	FALSO
$N_q = 1$	FALSO
$N_\gamma = 0$ se $\phi = 0$	FALSO
$N_\gamma = -2$ sen ω se $\phi \neq 0$	FALSO

per $\phi > 0$	A1+M1+R3
$N_c = (N_q - 1)$ ctg ϕ	23.92
$N_q = K_p \cdot e^{\pi tg\phi}$	13.19
$N_\gamma = 2\,(N_q + 1) \cdot tg\phi$	14.46

Fattori di forma s_c, s_q, e s_γ ($B/L \leq 1$)

per c > 0 e $\phi = 0$	
$s_c = 1 + [B'/(2 + \pi) \cdot L']$	FALSO
$s_q = 1$	FALSO
$s_\gamma = 1 - 0{,}4\,(B'/L')$	FALSO

per $\phi > 0$	A1+M1+R3
$s_c = 1 + (N_q \cdot B')/(Nc \cdot L')$	1.16
$s_q = 1 + (B'/L' \cdot tg\phi)$	1.15
$s_\gamma = 1 - 0{,}4\,(B'/L')$	0.88

Fattori di profondità d_c, d_q, e d_γ

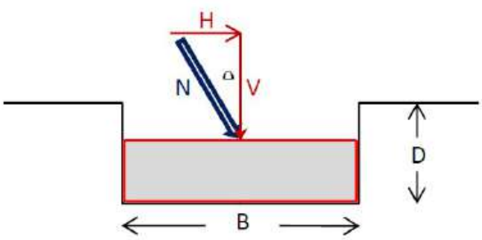
Si definisce il seguente parametro:

K = D/B' = 0.23 se D/B' $\leq$ 1 K = arctg D/B' = N.R. se D/B' > 1

per c > 0 e $\phi = 0$	
$d_c = 1 + 0{,}4$ K	FALSO
$d_q = 1$	FALSO
$d_\gamma = 1$	FALSO

per $\phi > 0$	A1+M1+R3
$d_c = d_q - [(1-d_q)/(N_c\ tag\phi)]$	1.07
$d_q = 1 + 2tg\phi(1 - sen\phi)^2 \cdot K$	1.07
$d_\gamma = 1$	1.00

Fattori di inclinazione del carico i_c, i_q, e i_γ



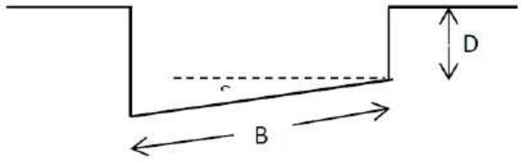
Si definisce il seguente parametro:

m = [2+ (B'/L')]/[(1+(B'/L')] = 1.77

per c > 0 e $\phi = 0$	
$i_c = 1 - [(m \cdot H)/(B' \cdot L' \cdot c_a \cdot N_c)]$	FALSO
$i_q = 1$	FALSO
$i_\gamma = 1$	FALSO

per $\phi > 0$	A1+M1+R3
$i_c = i_q - [(1-i_q)/(N_c \cdot tag\phi)]$	1.00
$i_q = [1-(H/(V+B' \cdot L' \cdot c_a \cdot ctg\phi)]^m$	1.00
$i_\gamma = [1-(H/(V+B' \cdot L' \cdot c_a \cdot ctg\phi)]^{m+1}$	1.00

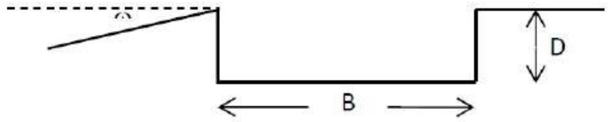
Fattori di inclinazione del piano di posa g_c, g_q, e g_γ (ε < 45°)



per c > 0 e ϕ = 0	
$g_c = 1 - [(2 \cdot \varepsilon)/(2+\pi)]$	FALSO
$g_q = 1$	FALSO
$g_\gamma = 1$	FALSO

per ϕ > 0	A1+M1+R3
$g_c = g_q - [(1-g_q)/(N_c \cdot tag\phi)]$	1.00
$g_q = (1 - \varepsilon \cdot tg\phi)^2$	1.00
$g_q = (1 - \varepsilon \cdot tg\phi)^2$	1.00

Fattori di inclinazione del piano di campagna b_c, b_q, e b_γ (ω < ϕ; ω < 45°)



per c > 0 e ϕ = 0	
$b_c = 1 - [(2 \cdot \omega)/(2+\pi)]$	FALSO
$b_q = 1$	FALSO
$b_\gamma = 1$	FALSO

per ϕ > 0	A1+M1+R3
$b_c = b_q - [(1-b_q)/(N_c \cdot tag\phi)]$	0.89
$b_q = (1 - tg\omega)^2 \cdot cos\omega$	0.90
$b_\gamma = b_q/cos\omega$	0.90

Fattori di correzione sismica inerziale z_c, z_q, e z_γ (Paolucci - Pecker)

$z_c = 1 - 0{,}32 \cdot K_{hi}$	0.99
$z_q = (1 - K_{hi} / tg\ \phi)^{0{,}35}$	0.98
$z_\gamma = (1 - K_{hi} / tg\ \phi)^{0{,}35}$	0.98

$k_{hi} = 0{,}2 \cdot a_g$	0.032

Fattori di correzione dell'effetto cinematico e_{yi}, e_{yk} (Maugeri - Cascone)

$e_{yk} = (1 - K_{hk} / tg\ \phi)^{0{,}45}$	0.96
$e_{yi} = (1 - 0{,}7\ K_{hi})^5$	0.89

$k_{hk} = \beta_s \cdot a_{max} / g$	0.047
$a_{max} = S_S \cdot S_T \cdot a_g$	0.192

VERIFICHE DI SICUREZZA AGLI STATI LIMITE ULTIMI (SLU)

Approccio 2 - Combinazione (A1 + M1 + R3)

Sono incrementate le azioni permanenti, incrementate le azioni variabili (A), invariati i parametri geotecnici (M) e ridotta la resistenza (R), secondo i coefficienti di seguito riportati:

Carichi	(A1)
Perman.	1.30
Perm. n.s.	1.50
Sovracc.	1.50

Par. geo.	(M1)
$tg\phi$	1.00
c	1.00
γ_t	1.00

Resist.	(R3)
Cap. port.	2.30
Scorr.	1.10

VERIFICA AL CARICO LIMITE **CONDIZIONI SISMICHE**

Carico limite	q_{lim} =	**606.89** KN/m^2
Resistenza del sistema geotecnico $R = q_{lim} \times B' \times L'$	R =	**40054.65** KN
Resistenza di progetto del sistema geotecnico $R_d = R/\gamma_r$	R_d =	**17415.07** KN
Valore di progetto dell'azione $E_d = G_{k1} + 1{,}3\ G_{k2} + 1{,}3\ Q_k$	E_d =	**520** KN

Deve essere rispettata la condizione **$E_d \leq R_d$** **(R_d / $E_d \geq 1$)**

520 < 17415.07 verifica soddisfatta

R_d / E_d = 33.49

VERIFICA ALLO SCORRIMENTO SUL PIANO DI POSA

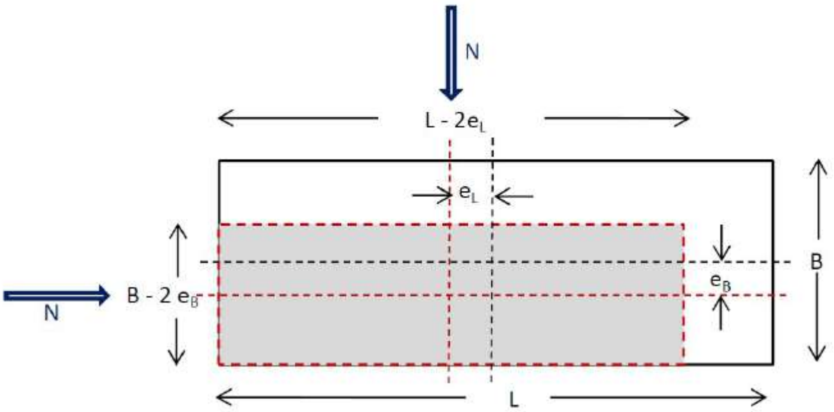
Res. di prog. sistema geotecnico $R_d = 1/\gamma_r \cdot [(c \cdot B' \cdot L')/\gamma_c + (N_d\ tg\phi/\gamma_\phi)]$	R_d =	**176.02** KN
Valore di progetto dell'azione $E_d = H$	E_d =	**0.00** KN

Deve essere rispettata la condizione **$E_d \leq R_d$** **(R_d / $E_d \geq 1$)**

0.00 < 176.02 verifica soddisfatta

CALCOLO CAPACITA' PORTANTE FONDAZIONI SUPERFICIALI (NTC 2018)

La fondazione è la parte di una struttura che serve a trasmettere il carico dell'opera al terreno sottostante attraverso la superficie di contatto (piano di posa). In accordo con la teoria di Terzaghi, una fondazione si definisce di tipo superficiale se D/B < 4, essendo D la profondità del piano di posa rispetto al piano di campagna e B la dimensione minima in pianta della fondazione.



Carichi permanenti	G_{k1} =	250	KN
Carichi permanenti non strutturali	G_{k2} =	130	KN
Sovraccarichi	Q_k =	0	KN
Risultante dei carichi verticali	N =	380	KN
Inclinazione della risultante N rispetto alla verticale	θ =	0	°
Componente orizzontale dei carichi agente sul piano di posa	H =	0.00	KN
Componente verticale dei carichi agente sul piano di posa	V =	380.00	KN
Eccentricità della risultante dei carichi parallela al lato B	e_B =	0.00	m
Eccentricità della risultante dei carichi parallela al lato L	e_L =	0.00	m
Largezza della fondazione all'appoggio sul terreno	B =	3.25	m
Lunghezza della fondazione	L =	6.90	m
Profondità del piano di posa della fondazione	D =	1.00	m
Largezza ridotta della fondazione per eccentricità del carico	B' =	3.25	m
Lunghezza ridotta della fondazione per eccentricità del carico	L' =	6.90	m
Coesione del terreno al di sotto del piano di posa	c =	0.00	KN/m^2
Adesione lungo la base della fondazione (ca < c)	c_a =	0.00	KN/m^2
Angolo di attrito del terreno al di sotto del piano di posa	ϕ =	27	°
Pressione geostatica sul piano di posa della fondazione	q =	17.2	KN/m^2
Peso unità di volume del terreno al di sotto del piano di posa	γ_t =	17.20	KN/m^3
Angolo di inclinazione del piano di campagna	ω =	3	°
Angolo di inclinazione del piano di posa	ε =	0	°

Parametri sismici

Stato limite considerato			SLV	
Accelerazione orizzontale massima attesa sul sito di riferimento		a_g =	0.159638	m/sec^2
Fattore di amplificazione spettrale max sul sito di riferimento		F_o =	2.582232	
Categoria di sottosuolo	B	β_s =	0.24	
Coefficiente di amplificazione stratigrafica		S_s =	1.20	
Categoria topografica	T1	S_T =	1.0	

Calcolo capacità portante fondazioni superficiali

pag. 1

Il carico limite unitario del terreno di fondazione, calcolato con la formula di Brinch - Hansen, è dato dalla seguente espressione:

$$q_{lim} = c \cdot N_c \cdot s_c \cdot d_c \cdot i_c \cdot g_c \cdot b_c \cdot z_c + q \cdot N_q \cdot s_q \cdot d_q \cdot i_q \cdot g_q \cdot b_q \cdot z_q + 0,5 \cdot B \cdot \gamma_t \cdot N_\gamma \cdot s_\gamma \cdot d_\gamma \cdot i_\gamma \cdot g_\gamma \cdot b_\gamma \cdot z_\gamma \cdot e_{\gamma k} \cdot e_{\gamma i}$$

Fattori di capacità portante N_c, N_q e N_γ

per c > 0 e ϕ = 0	
$N_c = 2 + \pi$	FALSO
$N_q = 1$	FALSO
$N_\gamma = 0$ se $\phi = 0$	FALSO
$N_\gamma = -2 \text{ sen } \omega$ se $\phi \neq 0$	FALSO

per ϕ > 0	A1+M1+R3
$N_c = (N_q - 1) \text{ ctg } \phi$	23.92
$N_q = K_p \cdot e^{\pi tg\phi}$	13.19
$N_\gamma = 2 (N_q + 1) \cdot tg\phi$	14.46

Fattori di forma s_c, s_q, e s_γ (B/L $\leq$ 1)

per c > 0 e ϕ = 0	
$s_c = 1 + [B'/(2 + \pi) \cdot L']$	FALSO
$s_q = 1$	FALSO
$s_\gamma = 1 - 0,4 (B'/L')$	FALSO

per ϕ > 0	A1+M1+R3
$s_c = 1+(N_q \cdot B')/(Nc \cdot L')$	1.26
$s_q = 1+(B'/L' \cdot tg\phi)$	1.24
$s_\gamma = 1-0,4 (B'/L')$	0.81

Fattori di profondità d_c, d_q, e d_γ

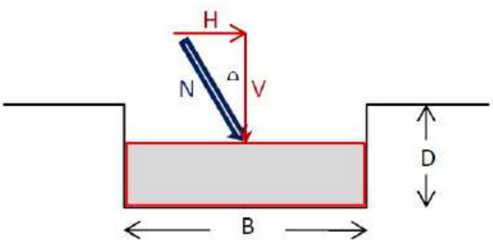
Si definisce il seguente parametro:

K = D/B' = 0.31 se D/B' $\leq$ 1 K = arctg D/B' = N.R. se D/B' > 1

per c > 0 e ϕ = 0	
$d_c = 1 + 0,4 K$	FALSO
$d_q = 1$	FALSO
$d_\gamma = 1$	FALSO

per ϕ > 0	A1+M1+R3
$d_c = d_q-[(1-d_q)/(N_c \text{ tag}\phi)]$	1.10
$d_q = 1+2tg\phi(1-sen\phi)^2 \cdot K$	1.09
$d_\gamma = 1$	1.00

Fattori di inclinazione del carico i_c, i_q, e i_γ



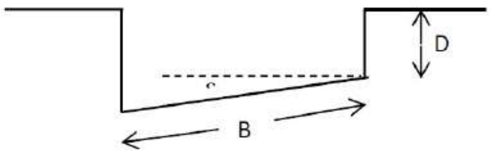
Si definisce il seguente parametro:

m = [2+ (B'/L')]/[(1+(B'/L')] = 1.68

per c > 0 e ϕ = 0	
$i_c = 1-[(m \cdot H)/(B' \cdot L' \cdot c_a \cdot N_c)]$	FALSO
$i_q = 1$	FALSO
$i_\gamma = 1$	FALSO

per ϕ > 0	A1+M1+R3
$i_c = i_q-[(1-i_q)/(N_c \cdot tag\phi)]$	1.00
$i_q = [1-(H/(V+B' \cdot L' \cdot c_a \cdot ctg\phi)]^m$	1.00
$i_\gamma = [1-(H/(V+B' \cdot L' \cdot c_a \cdot ctg\phi)]^{m+1}$	1.00

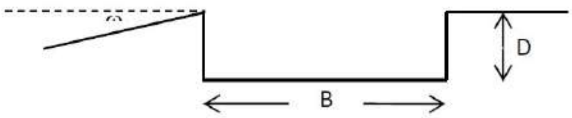
Fattori di inclinazione del piano di posa g_c, g_q, e g_γ (ε < 45°)



per c > 0 e ϕ = 0	
$g_c = 1 - [(2 \cdot \varepsilon)/(2+\pi)]$	FALSO
$g_q = 1$	FALSO
$g_\gamma = 1$	FALSO

per ϕ > 0	A1+M1+R3
$g_c = g_q - [(1-g_q)/(N_c \cdot tag\phi)]$	1.00
$g_q = (1 - \varepsilon \cdot tg\phi)^2$	1.00
$g_q = (1 - \varepsilon \cdot tg\phi)^2$	1.00

Fattori di inclinazione del piano di campagna b_c, b_q, e b_γ ($\omega < \phi$; ω < 45°)



per c > 0 e ϕ = 0	
$b_c = 1 - [(2 \cdot \omega)/(2+\pi)]$	FALSO
$b_q = 1$	FALSO
$b_\gamma = 1$	FALSO

per ϕ > 0	A1+M1+R3
$b_c = b_q - [(1-b_q)/(N_c \cdot tag\phi)]$	0.89
$b_q = (1 - tg\omega)^2 \cdot cos\omega$	0.90
$b_\gamma = b_q / cos\omega$	0.90

Fattori di correzione sismica inerziale z_c, z_q, e z_γ (Paolucci - Pecker)

$z_c = 1 - 0{,}32 \cdot K_{hi}$	0.99
$z_q = (1 - K_{hi} / tg\ \phi)^{0,35}$	0.98
$z_\gamma = (1 - K_{hi} / tg\ \phi)^{0,35}$	0.98

$k_{hi} = 0{,}2 \cdot a_g$	0.032

Fattori di correzione dell'effetto cinematico e_{yi}, e_{yk} (Maugeri - Cascone)

$e_{yk} = (1 - K_{hk} / tg\ \phi)^{0,45}$	0.96
$e_{yi} = (1 - 0{,}7\ K_{hi})^5$	0.89

$k_{hk} = \beta_s \cdot a_{max} / g$	0.047
$a_{max} = S_S \cdot S_T \cdot a_g$	0.192

VERIFICHE DI SICUREZZA AGLI STATI LIMITE ULTIMI (SLU)

Approccio 2 - Combinazione (A1 + M1 + R3)

Sono incrementate le azioni permanenti, incrementate le azioni variabili (A), invariati i parametri geotecnici (M) e ridotta la resistenza (R), secondo i coefficienti di seguito riportati:

Carichi	(A1)
Perman.	1.30
Perm. n.s.	1.50
Sovracc.	1.50

Par. geo.	(M1)
tgϕ	1.00
c	1.00
γ_t	1.00

Resist.	(R3)
Cap. port.	2.30
Scorr.	1.10

VERIFICA AL CARICO LIMITE **_CONDIZIONI SISMICHE_**

Carico limite	q_{lim} =	**515.84** KN/m^2
Resistenza del sistema geotecnico $R = q_{lim} \times B' \times L'$	R =	**11567.81** KN
Resistenza di progetto del sistema geotecnico $R_d = R/\gamma_r$	R_d =	**5029.48** KN
Valore di progetto dell'azione $E_d = G_{k1} + 1{,}3\ G_{k2} + 1{,}3\ Q_k$	E_d =	**520** KN

Deve essere rispettata la condizione **$E_d \leq R_d$** **(R_d / $E_d \geq 1$)**

520 < 5029.48 verifica soddisfatta

R_d / E_d = 9.67

VERIFICA ALLO SCORRIMENTO SUL PIANO DI POSA

Res. di prog. sistema geotecnico $R_d = 1/\gamma_r \cdot [(c \cdot B' \cdot L')/\gamma_c + (N_d\ tg\phi/\gamma_\phi)]$	R_d =	**176.02** KN
Valore di progetto dell'azione $E_d = H$	E_d =	**0.00** KN

Deve essere rispettata la condizione **$E_d \leq R_d$** **(R_d / $E_d \geq 1$)**

0.00 < 176.02 verifica soddisfatta

'DL FDOFROL LQQDQ]L HIIHWWXDWL VL HYLQFH FKH LO WI
YHULILFD GL VWDELOLWj GHO SHQGLR HUDP YLVWR FKH LO
LQWHUQR SHQGHQ]D WHUUHQR QHOOD VLWXD]LRQH DQWH
VLFXUH]]D VLFXUDPHQWH PROWR VXSHULRUH DG GRYH V
DJHQWL ,QILQH OH RSHUH SURJHWWXDOL QRQ SUHYHGRQ

7DQWR 'RYHYDVL ,/ *(2/2*2

'RWW 9LWR) 3/

%LEOLRJUDILD

5(*,21(38*/,$ &DUWD 7HFQLFD 5HJLRQDOH & 7 5 HOHPHQW
DOOD VFDOD

5HJRODPHQWR 5HJLRQDOH 0DU]R Q H GDOOD / 5 GH
OHWW E H $UW FRPPD ELV

0LQLVWHUR GHOO¶,QGXVWULD GHO &RPPHUFLR H GHOO¶$U
6HUYL]LR *HRORJLFR G¶,WDOLD ± 1RWH LOOXVWUDWLYH GH
6DQ 6HYHUR

1RWH LOOXVWUDWLYH GHOOD FDUWD JHRORJLFD DOOD VFD

$XWRULWj GL %DFLQR))RUWRUH

,O 'LSDUWLPHQWR 6HUYL]LR *HRORJLFR G¶,WDOLD LQ ,635$
3URJHWWR ,)), ,QYHQWDULR GHL)HQRPHQL)UDQRVL LQ ,W

(1, $FTXH GROFL VRWWHUUDQHH ³,QYHQWDULR GHL GDWL
LQ ,WDOLD´

' 0 H GHOOD &LUFRODUH GHO & 6 // 33 Q GHO

& &HVWHOOL *XLGL *HRWHFQLFD H WHFQLFD GHOOH IRQGD

$UDL + H 7RNLPDWVX . 6 :DYH 9HORFLW\ 3URILOLQJ E\ ,QYHUVLRQ
RI 0LFURWUHPRU + 9 6SHFWUXP %XOO 6HLVP 6RF $P

'HOJDGR - /RSH] &DVDGR & *LQHU - (VWHYH] $ &XHQF
0LFURWUHPRUV DV D JHRSK\VLFDO H[SORUDWLRQ WRRO DS
3XUH $SSO *HRSK\V

1DNDPXUD < $ PHWKRG IRU G\QDPLF FKDUDFWHULVWL
PLFURWUHPRU RQ WKH JURXQG VXUIDFH 45 RI 575,

%DUG 3 < 0LFURWUHPRU PHDVXUHPHQWV D WRRO IR
HVWLPDWLRQ" 6HFRQG ,QWHUQDWLRQDO 6\PSRVLXP RQ WK
RI WKH 6XUIDFH *HRORJ\ RQ 6HLVPLF 0RWLRQ (6* -DSDQ

%RUFKHUGW 5 ' 6LPSOLILHG VLWH FODVVHV DQG HPS
IDFWRUV IRU VLWH GHSHQGHQW FRGH SURYLVLRQV LQ
1&((5 6($2& %66& :RUNVKRS RQ 6LWH 5HVSRQVH GXULQJ
(DUWKTXDNHV DQG 6HLVPLF &RGH 3URYLVLRQV
8QLYHUVLW\ RI 6RXWKHUQ &DOLIRUQLD /RV $QJHOHV &DO

%RUFKHUGW 5 ' (VWLPDWHV RI VLWH GHSHQGHQW UH
VSHFWUD IRU GHVLJQ PHWKRGRORJ\ DQG MXVWLILFDWLRQ

%XGQ\ 0 6HLVPLVFKH %HVWLPPXQJ GHU ERGHQG\QDPLVFKH
REHUIOlFKHQQDKHQ 6FKLFKWHQ LQ (UGEHEHQJHELHWHQ GH
VHLVPRORJLVFKH 3K' 7KHVLV $QZHQGXQJ 6SHFLDOLWDWLRQV 1R *HRORJLV
8QLYHUVLWlW
]X .|OQ SS LQ *HUPDQ

&DVWHOODUR 6 0XODUJLD) H %LDQFRQL / 6WUDWL
DFFXUDWD UDSL *HRORJLD 7HFQLFD H $PELHQWDOH

0XODUJLD) H &DVWHOODUR 6 E 6LQJOH VWDWLRQ SD
WR DOPRVW NP GHSWK 5RPD *1*76

%HQ 0HQDKHP $ H 6LQJK 6 - 6HLVPLF ZDYHV DQG VRX
SS

0XFFLDUHOOL 0 H *DOOLSROL 0 5 &RPSDULVRQ EHWZ
DPSOLILFDWLRQ LQ ,WDO\ &RQI (DUWKT (QJ DQG 6HLVPR

5HJLRQH $EUX]]R GLSDUWLPHQWR GHOOD SURWH]LRQH FLY
SHU OD ULFRVWUX]LRQH GHOO¶DUHD DTXLODQD

$//(*$7,

3529$ 3(1(7520(75,&$ ',1$0,&$

&RPPLWWHQWH ,QJ 5RVHOOL 1LFROD
&DQWLHUH ,PSLDQWR DJULYROWDLFR
/RFDOLWj 6HUUDFDSULROD)*

&DUDWWHULVWLFKH 7HFQLFKH 6WUXPHQWDOL 6RQGD '36+ 'LQDPLF 3URELQJ

5LI 1RUPH	',1
3HVR 0DVVD EDWWHQWH	.J
$OWH]]D GL FDGXWD OLEHUD	P
3HVR VLVWHPD GL EDWWXWD	.J
'LDPHWUR SXQWD FRQLFD	PP
$UHD GL EDVH SXQWD	FPð
/XQJKH]]D GHOOH DVWH	P
3HVR DVWH D PHWUR	.J P
3URIRQGLWj JLXQ]LRQH SULPD DVWD	P
$YDQ]DPHQWR SXQWD	P
1XPHUR FROSL SHU SXQWD	1
&RHII &RUUHOD]LRQH	
5LYHVWLPHQWR IDQJKL	1R
$QJROR GL DSHUWXUD SXQWD	ƒ

3529(3(1(7520(75,&+(',1$0,&+(&217,18(

'<1$0,& 352%,1*

'36+

1RWH LOOXVWUDWLYH   'LYHUVH WLSRORJLH GL SHQHWURP
/D SURYD SHQHWURPHWULFD GLQDPLFD FRQVLVWH QHOO¶
FRQVHFXWLYL PLVXUDQGR LO QXPHUR GL FROSL 1 QHFHVVDUL
/H 3URYH 3HQHWURPHWULFKH 'LQDPLFKH VRQR PROWR GL
JHRWHFQLFL GDWD OD ORUR VHPSOLFLWj HVHFXWLYD HFF

/D ORUR HODERUD]LRQH LQWHUSUHWD]LRQH H YLVXDO
SDUDPHWUL]]DUH´ LO VXROR DWWUDYHUVDWR FRQ XQ¶LPP
UDIIURQWR VXOOH FRQVLVWHQ]H GHL YDUL OLYHOOL DW
JHRJQRVWLFL SHU OD FDUDWWHUL]]D]LRQH VWUDWLJUDIL
ULFRQRVFHUH DEEDVWDQ]D SUHFLVDPHQWH OR VSHVVRUH
H VXSHUILFL GL URWWXUD VXL SHQGLL   H OD FRQVLVWHQ]D

/¶XWLOL]]R GHL GDWL ULFDYDWL GD FRUUHOD]LRQL LQGL
FRPXQTXH HVVHUH WUDWWDWR FRQ OH RSSRUWXQH FDXW
DFTXLVLWH LQ]RQD

(OHPHQWL FDUDWWHULVWLFL GHO SHQHWURPHWUR GLQDPL

SHVR PDVVD EDWWHQWH 0
DOWH]]D OLEHUD FDGXWD +
SXQWD FRQLFD GLDPHWUR EDVH FRQR ' DUHD EDVH
DYDQ]DPHQWR GSHQHWUD]LRQH
SUHVHQ]D R PHQR GHO ULYHVWLPHQWR HVWHUQR IDQ

&RQ ULIHULPHQWR DOOD FODVVLILFD]LRQH ,660)(GHL

WDEHOOD VRWWR ULSRUWDWD VL ULOHYD XQD SULPD VXG

PDVVD EDWWHQWH

WLSR /(**(52 '3/

WLSR 0(',2 '30

WLSR 3(6$17('3+

WLSR 683(53(6$17('36+

&ODVVLILFD]LRQH ,660)(GHL SHQHWURPHWUL GLQDPLFL

7LSR	6LJOD GL ULIHULPHQWR	SURISHVR LQGLFDWLYR 0 NJ	PDVVD EDWWHQWH P
/HJJHUR	'3/ /LJKW	0 d	
0HGLR	'30 0HGLXP		0
3HVDQWH	'3+ +HDY\	0	
6XSHU SHVDQWH +HDY\	'36+ 6XSHU	0t	

SHQHWURPHWUL LQ XVR LQ ,WDOLD

,Q ,WDOLD ULVXOWDQR DWWXDOPHQWH LQ XVR L VHJXHQWL 6WDQGDUG

,660)(

',1$0,&2 683(53(6$17(7LSR (0,/,$

0DVVD EDWWHQWH 0 NJ DOWH]]D FDGXWD +XQWD FRQLFD
FRQLFD ƒ ƒ GLDPHWUR ' PP DUHD EDVH
EHQWRQLWLFR WDORUD SUHYLVWR

&RUUHOD]LRQH FRQ 1VSW

3RLFKp OD SURYD SHQHWURPHWULFD VWDQGDUG 637 UDS
HFRQRPLFL SHU ULFDYDUH LQIRUPD]LRQL GDO VRWWRVXRO
ULJXDUGDQR L YDORUL GHO QXPHUR GL FROSL 1VSW RWWH
QHFHVVLWj GL UDSSRUWDUH LO QXPHUR GL FROSL GL XQD
GD

$$1VSW E_W 1$$

'RYH

$$E_W \frac{4}{4_{637}}$$

LQ FXL 4 q O¶HQHUJLD VSHFLILFD SHU FROSR H 4VSW q TXH
/¶HQHUJLD VSHFLILFD SHU FROSR YLHQH FDOFRODWD FRPH

$$4 \frac{0 \;˜+}{\$˜G˜0 \quad 0}$$

LQ FXL
0 SHVR PDVVD EDWWHQWH
0¶ SHVR DVWH
+ DOWH]]D GL FDGXWD
$ DUHD EDVH SXQWD FRQLFD
G SDVVR GL DYDQ]DPHQWR

9DOXWD]LRQH UHVLVWHQ]D GLQDPLFD DOOD SXQWD 5SG
)RUPXOD 2ODQGHVL

$$5SG \frac{0 \;˜+}{\$˜H˜0 \quad 3} @ \frac{0 \;˜+˜1}{\$˜G˜0 \quad 3} @$$

5SG UHVLVWHQ]D GLQDPLFD SXQWD DUHD $
H LQILVVLRQH PHGLD SHU FROSR
0 SHVR PDVVD EDWWHQWH DOWH]]D FDGXWD +
3 SHVR WRWDOH DVWH H VLVWHPD EDWWXWD

0HWRGRORJLD GL (ODERUD]LRQH

/H HODERUD]LRQL VRQR VWDWH HIIHWWXDWH PHGLDQWH
3URELQJ *HR6WUX 6RIWZDUH

,O SURJUDPPD FDOFROD LO UDSSRUWR GHOOH HQHUJLH W
WUDPLWH OH HODERUD]LRQL SURSRVWH GD 3DVTXDOLQL
)UDQNRZVN\
3HUPHWWH LQROWUH GL XWLOL]]DUH L GDWL RWWHQXWL
HVWUDSRODUH XWLOL LQIRUPD]LRQL JHRWHFQLFKH H JHRO
8QD YDVWD HVSHULHQ]D DFTXLVLWD XQLWDPHQWH DG XQD
VSHVVR GL RWWHQHUH GDWL XWLOL DOOD SURJHWWD]LRQ
WDQWL GDWL ELEOLRJUDILFL VXOOH OLWRORJLH H GL GD
SRFKH SURYH GL ODERUDWRULR HVHJXLWH FRPH UDSSUH
GLVXQLIRUPH H R FRPSOHVVD
,Q SDUWLFRODUH FRQVHQWH GL RWWHQHUH LQIRUPD]LRQL

O¶DQGDPHQWR YHUWLFDOH H RUL]]RQWDOH GHJOL LQ
OD FDUDWWHUL]]D]LRQH OLWRORJLFD GHOOH XQLWj V
L SDUDPHWUL JHRWHFQLFL VXJJHULWL GD YDUL DXWR
GHOOH UHVLVWHQ]D DOOD SXQWD

9DOXWD]LRQL VWDWLVWLFKH H FRUUHOD]LRQL

(ODERUD]LRQH 6WDWLVWLFD

3HUPHWWH O¶HODERUD]LRQH VWDWLVWLFD GHL GDWL QXPH
YDORUL UDSSUHVHQWDWLYL GHOOR VWUDWR FRQVLGHUDWR
GHOOR VWUDWR GDWR FRPXQTXH PDJJLRUPHQWH XWLOL]]

0HGLD

0HGLD DULWPHWLFD GHL YDORUL GHO QXPHUR GL FROS
GRYH Q q LO QXPHUR GL OHWWXUH

3UHVVLRQH DPPLVVLELOH

3UHVVLRQH DPPLVVLELOH VSHFLILFD VXOO¶LQWHUVWUDWR
DVWH R QR FDOFRODWD VHFRQGR OH QRWH HODERUD]LRQ
GL VLFXUH]]D JHQHUDOPHQWH FKH FRUULVSRQGH D
IRQGD]LRQL SDUL D FRQ XQD JHRPHWULD IRQGDOH VWDQ
G PW

&RUUHOD]LRQL JHRWHFQLFKH WHUUHQL LQFRHUHQWL

/LTXHID]LRQH

3HUPHWWH GL FDOFRODUH XWLOL]]DQGR GDWL 1VSW L

SUHYDOHQWHPHQWH VDEELRVL

$WWUDYHUVR OD UHOD]LRQH GL 6+,1*$ 0,1* DSSOLFDELOH D WHUUHQL VDE

ULVXOWD SRVVLELOH VROD PHQWH VH 1VSW GHOOR VWU

FDOFRODWR FRQ OD HODERUD]LRQH GL 6+,1*$

&RUUH]LRQH 1VSW LQ SUHVHQ]D GL IDOGD

1VSW FRUUHWWR î 1VSW

1VSW q LO YDORUH PHGLR QHOOR VWUDWR

/D FRUUH]LRQH YLHQH DSSOLFDWD LQ SUHVHQ]D GL ID

OD FRUUH]LRQH YLHQH HVHJXLWD VH WXWWR OR VW

$QJROR GL DWWULWR

3HFN +DQVRQ 7KRUQEXUQ 0H\HUKRI &RUUHOD]LRQ

PW FRUUHOD]LRQH YDOLGD SHU VDEELH H JKLDLH

VWRULFD PROWR XVDWD YDOHYROH SHU SURI PW

IDOGD WHQVLRQL W PT

0H\HUKRI &RUUHOD]LRQL YDOLGH SHU VDEELH D

WHUUHQL GL ULSRUWR VFLROWL H FROWUL GHWULWLFK

6RZHUV $QJROR GL DWWULWR LQ JUDGL YDOLGR

PW VRSUD IDOGD H PW SHU WHUUHQL LQ IDOGD

'H 0HOOR &RUUHOD]LRQH YDOLGD SHU WHUUHQL SUH

PRGLILFD VSHULPHQWDOH GL GDWL FRQ DQJROR GL D

0DOFHY $QJROR GL DWWULWR LQ JUDGL YDOLGR S

! P H SHU YDORUL GL DQJROR GL DWWULWR ƒ

6FKPHUWPDQQ $QJROR GL DWWULWR JUDGL SHU Y

YDORUL VSHVVR WURSSR RWWLPLVWLFL SRLFKp GHVXQ

6KLRL)XNXQL 52$' %5,'*(63(&,),&$7,21 $QJROR GL

SHU VDEELH VDEELH ILQL R OLPRVH H OLPL VLOWRVL

VRSUD IDOGD H ! PW ! SHU WHUUHQL LQ IDOGD

6KLRL)XNXQL -$3$1(6(1$7,21$/(5$,/:$< $QJROR G

SHU VDEELH PHGLH H JURVVRODQH ILQR D JKLDLRVH

$QJROR GL DWWULWR LQ JUDGL 2ZDVDNL ,ZDVDNL YI
JURVVRODQH FRQ KLDRWWH LPDPDOL SHU SURI ! PW VRSUD
IDOGD V! W PT
0H\HUKRI &RUUHOD]LRQH YDOLGD SHU WHUUHQL
SURIRQGLWj PW H FRQ GL OLPR ! D SURIRQGLW
0LWFKHOO H .DWWL &RUUHOD]LRQH YDOLGD SHU

'HQVLWj UHODWLYD
*LEEV +ROW] FRUUHOD]LRQH YDOLGD SHU TXDOX
YLHQH VRYUDVWLPDWR SHU OLPL
6NHPSWRQ HODERUDWD VLD SHU VDEELH ILQL H JURVVH
TXDOXQTXH SUHVVLRQH HIILFDFH SHU JKLDLH LO YDOR
VRWWRVWLPDWR
0H\HUKRI
6FKXOW]H 0HQ]HQEDFK JKLDLH YDOLGR SHU
YDORUH GL SUHVVLRQH HIILFDFH LQ GHSRVLWL 1& SHU
SHU OLPL VRWWRVWLPDWR

0RGXOR 'L (\RXQJ
7HU]DJKL HODERUD]LRQH VDEELD FRQ QL]DEELD
SUHVVLRQH HIILFDFH
6FKPHUWPDQQ FRUUHOD]LRQH YDOLGD SHU YDUL
6FKXOW]H 0HQ]HQEDFK FRUUHOD]LRQH YDOLGD SHU Y
' $SSROORQLD HG DOWUL FRUUHOD]LRQH YDOLG
%RZOHV FRUUHOD]LRQH YDOLGD SHU VDEELD DUJ
VDEELD PHGLD VDEELD H JKLDLD

0RGXOR (GRPHWULFR
%HJHPDQQ HODERUD]LRQH GHVXQWD GD HVSHULH
OLPR FRQ VDEELD VDEELD H JKLDLD
%XLVPDQQ 6DQJOHUDW FRUUHOD]LRQH YDOLGD SHU V
)DUUHQW YDOLGD SHU VDEELH WDORUD DQFKH SH
VSHULPHQWDOH GL GDWL
0HQ]HQEDFK H 0DOFHY YDOLGD SHU VDEELD ILQH VDE

6WDWR GL FRQVLVWHQ]D

&ODVVLILFD]LRQH $ * ,

3HVR GL YROXPH *DPPD

0H\HUKRI HG DOWUL YDOLGD SHU VDEELH JKLDLH OL...

3HVR GL YROXPH VDWXUR

%RZOHV 7HU]DJKL 3HFN &RUUHOD]LRQH YD...

PDWHULDOH SDUL D PEUHFD SHU SHVR GL YROXPH VHFFR V...

D 1VSW

0RGXOR GL SRLVVRQ

x &ODVVLILFD]LRQH $ * ,

3RWHQ]LDOH GL 6WUXWWXUD]LRQH

6HHG ,GULVV 7DOH FRUUHOD]LRQH q YDOLGD V...

VDEELRVL UDSSUHVHQWD LO UDSSRUWR WUD WHQVLRQH V...

FRQVROLGD]LRQH SHU OD YDOXWD]LRQH GHO SRWHQ]LD...

JKLDLRVL DWWUDYHUVR JUDILFL GHJOL DXWRUL

9HORFLWj RQGH GL WDJOLR

7DOH FRUUHOD]LRQH q YDOLGD VRODPHQWH SHU WHUU...

0RGXOR GL GHIRUPD]LRQH GL WDJOLR

2KVDNL ,ZDVDNL ± HODERUD]LRQH YDOLGD SHU VDEEL...

5REHUWVRQ H &DPSDQHOOD H ,PDL 7RQRXFKL

SHU VDEELH WHQVLRQL OLWRVWDWLFKH FRPSUHVH WUD...

0RGXOR GL UHD]LRQH

1DYIDF HODERUD]LRQH YDOLGD SHU VDEELH

5HVLVWHQ]D DOOD SXQWD GHO 3HQHWURPHWUR 6WDWLFR

5REHUWVRQ 4F

&RUUHOD]LRQL JHRWHFQLFKH WHUUHQL FRHVLYL

&RHVLRQH QRQ GUHQDWD

%HQDVVL 9DQQHOOL FRUUHOD]LRQL VFDWXULWH GD

681'$

7HU]DJKL 3HFN FRUUHOD]LRQH YDOLGD SHU D

DUJLOOH OLPRVH VLOWRVH PHGLDPHQWH SODVWLFK

7HU]DJKL 3HFN &X PLQ PD[

6DQJOHUDW GD GDWL 3HQHWU 6WDWLFR SHU WHUUHQ

SHU DUJLOOH VHQVLWLYH FRQ VHQVLWLYLWj ! SHU D

EDVVD SODVWLFLWj

6DQJOHUDW SHU DUJLOOH OLPRVH VDEELRVH SRFR F

SHQHWURPHWULFKH FRQL SHU UHVLVWHQ]H SHQH

FRPXQTXH TXHOOD GHOOH DUJLOOH SODVWLFKH GL 6

8 6 ' 0 6 0 8 6 'HVLJQ 0DQXDO 6RLO 0HFKDQLFV &RH

OLPRVH H DUJLOOH GL EDVVD PHGLD HG DOWD SODVWL

6FKPHUWPDQQ &X .J FPT YDOLGD SHU DUJLOOH H

1F H 4F 1VSW

6FKPHUWPDQQ &X .J FPT YDORUL PLQLPL YDOLG

)OHWFKHU $UJLOOD GL &KLFDJR &RHVLRQH QR

YDOLGL SHU DUJLOOH D PHGLR EDVVD SODVWLFLWj

+RXVWRQ DUJLOOD GL PHGLD DOWD SODVWLFLWj

6KLRL)XNXQL YDOLGD SHU VXROL SRFR FRHUHQW

%HJHPDQQ

'H %HHU

5HVLVWHQ]D DOOD SXQWD GHO 3HQHWURPHWUR

5REHUWVRQ 4F

0RGXOR (GRPHWULFR &RQILQDWR

6WURXG H %XWOHU SHU OLWRWLSL D PHGLD SOD

PHGLR DOWD SODVWLFLWj GD HVSHULHQ]H VX DUJLOO

6WURXG H %XWOHU SHU OLWRWLSL D PHGLR EDVV
DUJLOORVL D PHGLR EDVVD SODVWLFLWj ,3 GD HV
9HVLF FRUUHOD]LRQH YDOLGD SHU DUJLOOH PROO
7URILPHQNRY 0LWFKHOO H *DUGQHU 0RGXOR &RQ
SHU OLWRWLSL DUJLOORVL H OLPRVL DUJLOORVL UDSS
%XLVPDQQ 6DQJOHUDW YDOLGD SHU DUJLOOH FRPSDW
DUJLOOH VDEELRVH 1VSW

0RGXOR 'L <RXQJ

6FKXOW]H 0HQ]HQEDFK 0LQ H 0D[FRUUHOD]LRQH Y
FRQ ,3 !
' $SSROORQLD HG DOWUL FRUUHOD]LRQH YDOLGD

6WDWR GL FRQVLVWHQ]D

&ODVVLILFD]LRQH $ * ,

3HVR0RGOXPH *DPPD
0H\HUKRI HG DOWUL YDOLGD SHU DUJLOOH DUJLOOH V

3HVR GL YROXPH VDWXUR
&RUUHOD]LRQH %RZOHV 7HU]DJKL 3HFN
SHVR VSHFLILFR GHO PDWHULDOH SDUL D FLUFD *
1VSW D 1VSW

3529$ 1U

6WUXPHQWR XWLOL]]DWR '36+ 'LQDPLF 3URELQJ 6XSHU +HDY\
3URYD HVHJXLWD LQ GDWD
3URIRQGLWj SURYD PW
)DOGD QRQ ULOHYDWD

7LSR HODERUD]LRQH 1U &ROSL 0HGLR

3URIRQG	1U &R	&DOFRO ULGX]L VRQGD	5HV GL ULGRV .J FPð	5HV GL .J FPð	3UHV DPPLVV FRQ ULG +HUPLQ 2ODQG .J FPð	3UHV DPPLVVLELOH +HUPLQLHU 2ODQGHVL .J FPð

67,0$ 3$5$0(75, *(27(&1,&, 3529$ 1U

7(55(1, ,1&2(5(17,
'HQVLWj UHODWLYD

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	'HQVLWj UHODWL
> @ 6WUI				6NHPSWI	
> @ 6WUI				6NHPSWI	
> @ 6WUI				6NHPSWI	
> @ 6WUI				6NHPSWI	

$QJROR GL UHVLVWHQ]D DO WDJOLR

'HVFUL]LR	1VSW	3URI P	6W	1VSW FRU SUHVHQ]L	&RUUHOD	$QJROR G DWWUL ƒ
> @ 6WUI				6KL)RXLNXQL 52$' %5,' 63(&,),&$7		
> @ 6WUI				6KL)RXLNXQL 52$' %5,' 63(&,),&$7		
> @ 6WUI				6KL)RXLNXQL 52$' %5,' 63(&,),&$7		
> @ 6WUI				6KL)RXLNXQL 52$' %5,' 63(&,),&$7		

0RGXOR (GRPHWULFR

'HVFUL]LR	1VSW	3URI P	6W	1VSW FRU SUHVHQ]L	&RUUHOD	0RGXOR (GRPHWULFR .J FPð
> @ 6WUI				%HJHPDQQ *KLDL VDE		
> @ 6WUI				%HJHPDQQ *KLDL VDE		
> @ 6WUI				%HJHPDQQ *KLDL VDE		
> @ 6WUI				%HJHPDQQ *KLDL VDE		

&ODVVLILFD]LRQH $*,

'HVFUL]LR	1VSW	3URI P	6W	1VSW FRU SUHVHQ]L	&RUUHOD	&ODVVLILFD]LRQ $*,
> @ 6WUI				&ODVVLI $ * ,		6&,2/72
> @ 6WUI				&ODVVLI $ * ,		32& $''(16$72
> @ 6WUI				&ODVVLI $ * ,		02'(5$7$0(17($''(16$72
> @ 6WUI				&ODVVLI $ * ,		02/72 $''(16$72

3HVR XQLWj GL YROXPH

'HVFUL]LR	1VSW	3URI P	6W	1VSW FRU SUHVHQ]L	&RUUHOD	*DPPD W Pñ
> @ 6WUI				0H\HUKRI		
> @ 6WUI				0H\HUKRI		
> @ 6WUI				0H\HUKRI		
> @ 6WUI				0H\HUKRI		

3HVR XQLWj GL YROXPH VDWXUR

'HVFUL]LR	1VSW	3URI	6W	1VSW FRU	&RUUHOD	*DPPD 6DWXUR

		P	SUHVHQ]I		W Pñ
> @ 6WUI				7HU]D3JHK	
> @ 6WUI				7HU]DJHK	
> @ 6WUI				7HU]D3JHK	
> @ 6WUI				7HU]D3JHK	

0RGXOR GL 3RLVVRQ

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	3RLVVRQ
> @ 6WUI				$ *	
> @ 6WUI				$ *	
> @ 6WUI				$ *	
> @ 6WUI				$ *	

0RGXOR GL GHIRUPD]LRQH D WDJOLR GLQDPLFR

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	* .J FPð
> @ 6WUI				2KVDNL SXC	
> @ 6WUI				2KVDNL SXC	
> @ 6WUI				2KVDNL SXC	
> @ 6WUI				2KVDNLEI SXC	

3529$ 1U

6WUXPHQWR XWLOL]]DWR '36+ 'LQDPLF 3URELQJ 6XSHU +HDY\
3URYD HVHJXLWD LQ GDWD
3URIRQGLWj SURYD PW
)DOGD QRQ ULOHYDWD

7LSR HODERUD]LRQH 1U &ROSL 0HGLR

3URIRQG	1U &R(	&DOFROR ULGX]LR(&KL	5HV GLQ ULGRWW .J FPð	5HV GLQ .J FPð	3UHV DPPLVVLE ULGX]L +HUPLQ 2ODQG .J FPð	3UHV DPPLVVLELOH +HUPLQLHU 2ODQGHVL .J FPð

67,0$ 3$5$0(75, *(27(&1,&, 3529$ 1U

7(55(1, ,1&2(5(17,
'HQVLWj UHODWLYD

'HVFUL]LRQ	1VSW	3URI P	6W	1VSW FRU SUHVHQ](	&RUUHOD(	'HQVLWj UHODWLYD
> @ 6WU					6NHPSWR	
> @ 6WU					6NHPSWR	
> @ 6WU					6NHPSWR	
> @ 6WU					6NHPSWR	

$QJROR GL UHVLVWHQ]D DO WDJOLR

'HVFUL]LRQ	1VSW	3URI P	6W	1VSW FRU SUHVHQ](	&RUUHOD(	$QJROR G DWWUL ƒ
> @ 6WU					6KLRFKLNXQL 52$' %5,' 63(&,),&$7	
> @ 6WU					6KLRFKLNXQL 52$' %5,' 63(&,),&$7	
> @ 6WU					6KLRFKLNXQL 52$' %5,' 63(&,),&$7	

> @ 6WUI				6KL)RXLNXQL 52$' %5,' 63(&,),&$7	

0RGXOR (GRPHWULFR

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	0RGXOR (GRPHWULFR .J FPð
> @ 6WUI				%XLVPDQ (	V
> @ 6WUI				%XLVPDQ (	V
> @ 6WUI				%XLVPDQ (	V
> @ 6WUI				%XLVPDQ (	V

&ODVVLILFD]LRQH $*,

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	&ODVVLILFD]LRQ $*,
> @ 6WUI				&ODVVLI $ * ,	32&2 $''(16$72
> @ 6WUI				&ODVVLI $ * ,	02'(5$7$0(17($''(16$72
> @ 6WUI				&ODVVLI $ * ,	$''(16$72
> @ 6WUI				&ODVVLI $ * ,	02/72 $''(16$72

3HVR XQLWj GL YROXPH

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	*DPPD W Pñ
> @ 6WUI				0H\HUKRI	
> @ 6WUI				0H\HUKRI	
> @ 6WUI				0H\HUKRI	
> @ 6WUI				0H\HUKRI	

3HVR XQLWj GL YROXPH VDWXUR

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	*DPPD 6DWXUR W Pñ
> @ 6WUI				7HU]D3JHK	
> @ 6WUI				7HU]D3JHK	
> @ 6WUI				7HU]D3JHK	
> @ 6WUI				7HU]D3JHK	

0RGXOR GL 3RLVVRQ

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	3RLVVRQ
> @ 6WUI				$ *	
> @ 6WUI				$ *	
> @ 6WUI				$ *	
> @ 6WUI				$ *	

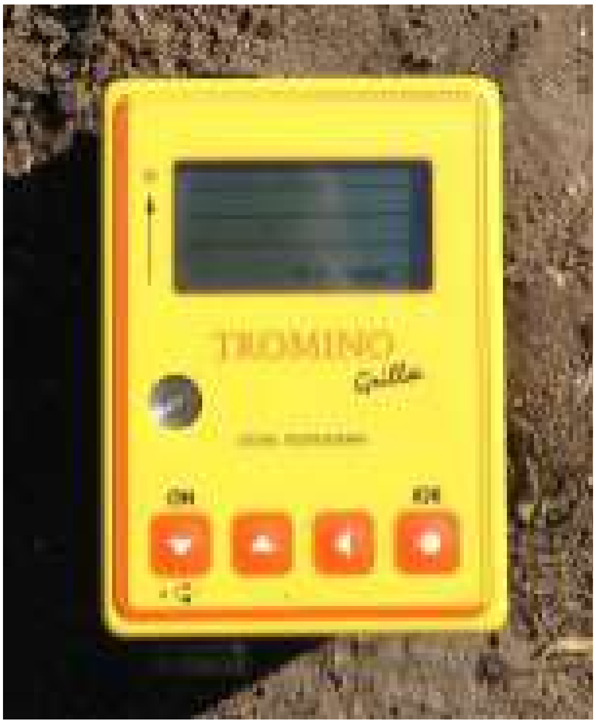
0RGXOR GL GHIRUPD]LRQH D WDJOLR GLQDPLFR

'HVFUL]LR	1VSW	3URI 6W P	1VSW FRU SUHVHQ]I	&RUUHOD	* .J FPð
> @ 6WUI				2KVDNL SXC	

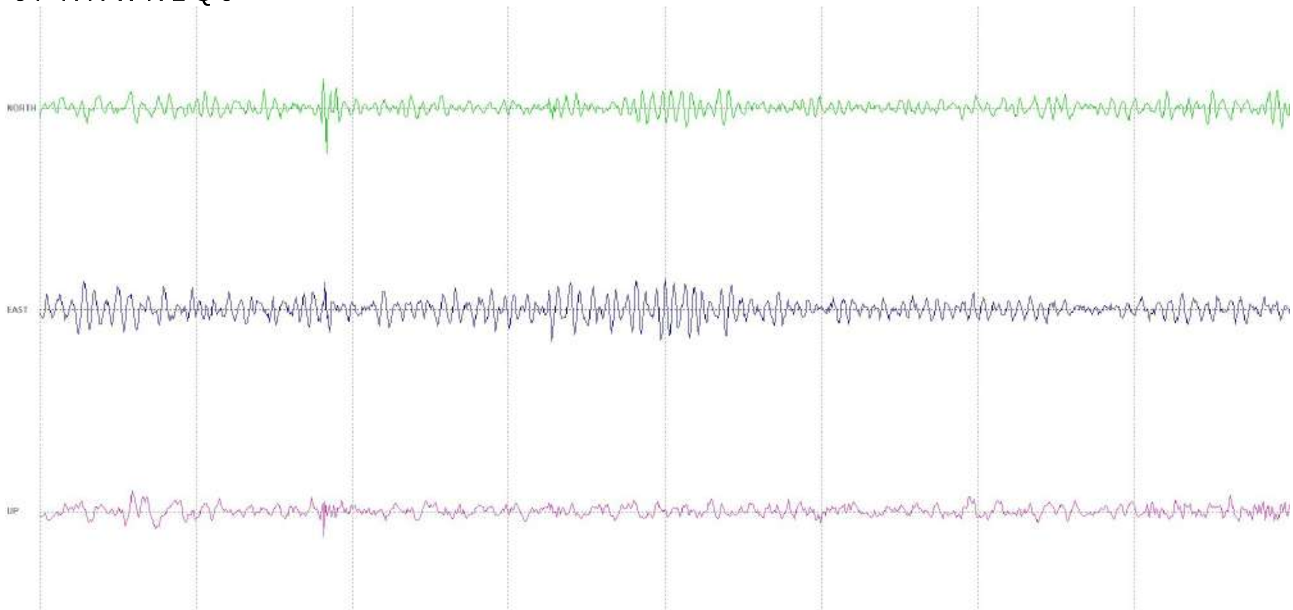
> @ 6WUI				2KVDNL SXC	
> @ 6WUI				2KVDNL SXC	
> @ 6WUI				2KVDNL SXC	

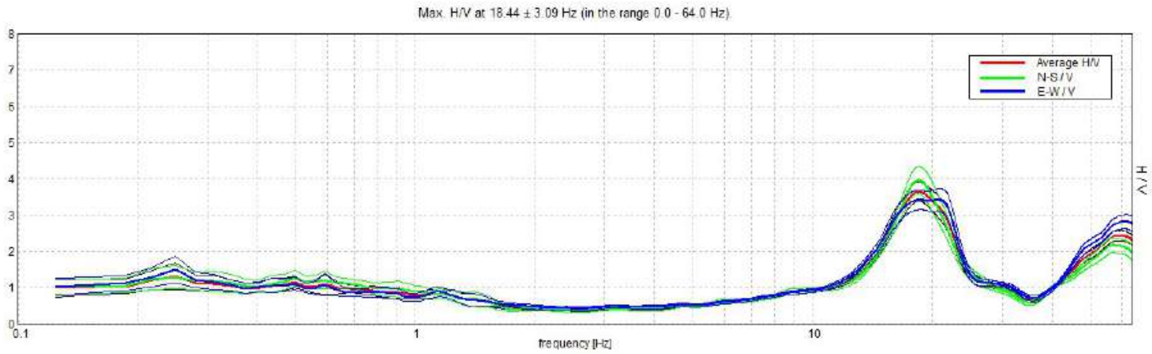
6,60,&$ +965

/H SURYH VLVPLFKH D ULIOHVVLRQH PXOWLSOD GHO WLSR
HIIHWWXDWH SHU PH]]R GL XQ WURPRJUDIR GLJLWDOH
O DFTXLVL]LRQH GHO UXPRUH VLVPLFR DPELHQWDOH VWUXPHQWR
GL SHVR GRWDWR GL WUH VHQVRUL HOHWWURGLQDPLFL YH
DOLPHQWDWR GD EDWWHULH $$ GD 9 H VHQ]D FDYL HV
D ELW HTXLYDOHQWL VRQR VWDWL DFTXLVLWL DOOH IU
DYHUH LQIRUPD]LRQL VX IUHTXHQ]H PDVVLPH GL +] 6L
TXDOH OD PDVVLPD IUHTXHQ]D UHJLVWUDELOH GHO
GHO VHJQDOH VWHVVR ,O ULVXOWDWR ILQDOH FRQVLVW
FLDVFXQD ILQHVWUD H QHOO LQWHUSUHWD]LRQH VHFRQ
IRQGDPHQWDOH GL ULVRQDQ]D GHO WHUUHQR GL IRQGD]L
GHL UDSSRUWL VWUDWLJUDILFL KD SHUPHVVR OD FODVVLI
' 0 H GHOOD &LUFRODUH GHO & 6 // 33 Q GHO
+965

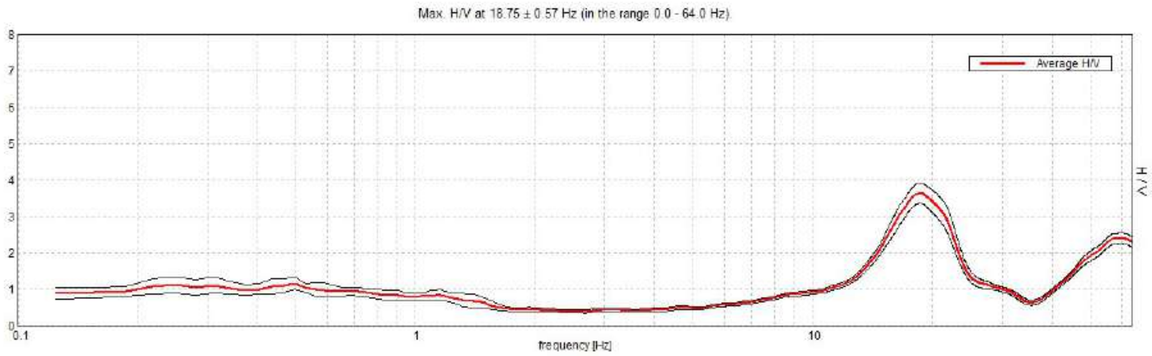


6(55$&$35,2/$)*965
,QVWUXPHQW 75=
'DWD IRUPDW E\WH
)XOO VFDOH >P9@ Q D
6WDUW UHFRUGLQJ (QG UHFRUGLQJ
&KDQQHO ODEHOV 1257+ 6287+ ($67 :(67 83 '2:1
7UDFH OHQJWK K $QDO\VLV SHUIRUPHG RQ WKH HQWLUH
6DPSOLQJ UDWH +]
:LQGRZ VL]H V
6PRRWKLQJ W\SH 7ULDQJXODU ZLQGRZ
6PRRWKLQJ

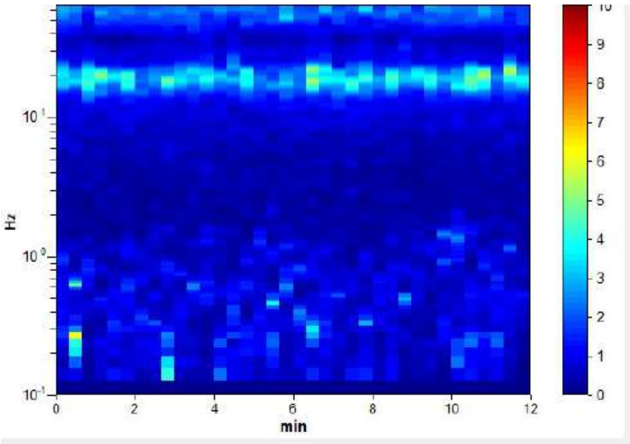


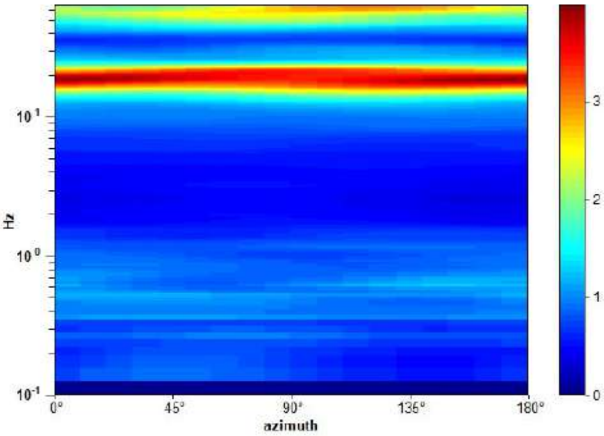


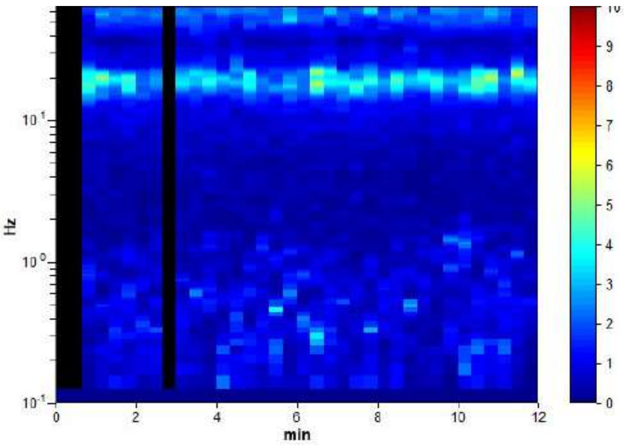
+25,=217$/ 72 9(57,&$/ 63(&75$/ 5$7,2

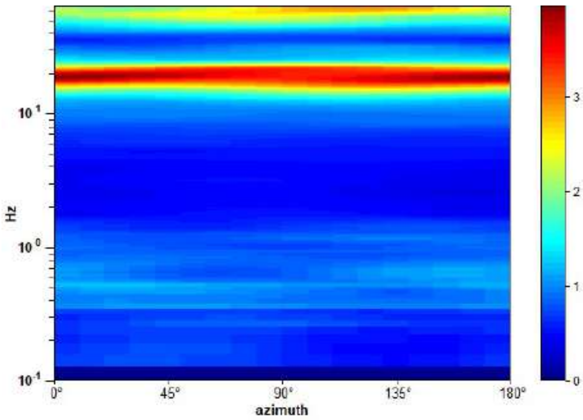


+ 9 7,0(+,6725< ',5(&7,21$/ + 9

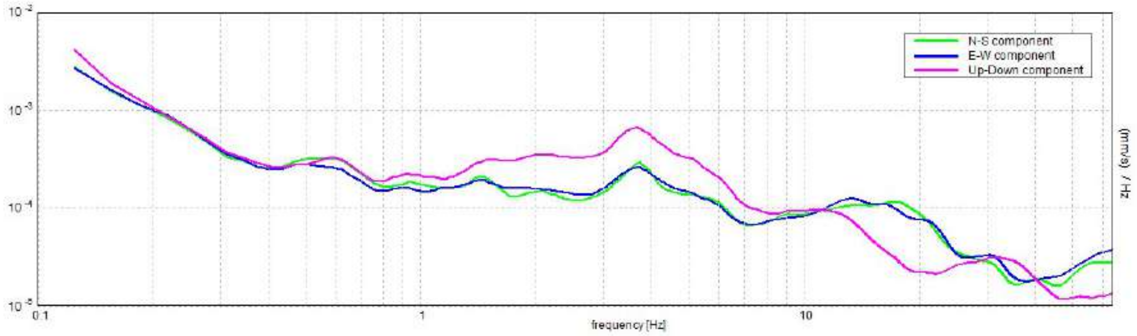




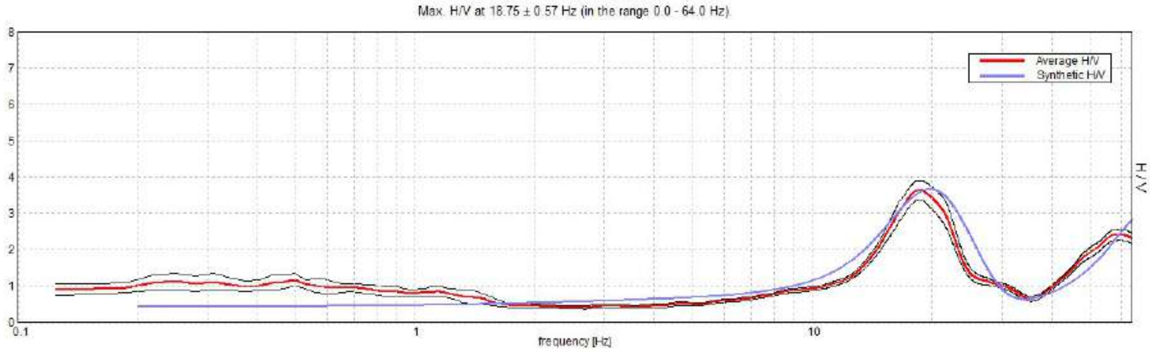




6,1*/(&20321(17 63(&75$



(;3(5,0(17$/ YV 6<17+(7,& + 9



02'(//2 '¶,19(56,21(35232672

3URIRQG	6SHVVRUH VLV	9HORFLWj RQGH 9V P V
LQI	LQI	

9VBHT P V

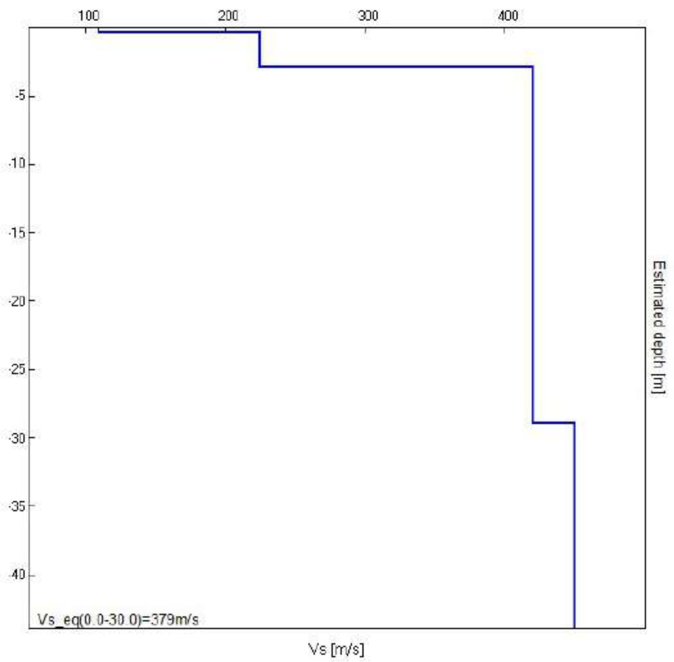


Tabella 1. Velocità caratteristiche delle onde S nei vari tipi di suolo [cfr. Borcherdt, 1994]

TIPO DI SUOLO	V_s min [m/s]	V_s media [m/s]	V_s max [m/s]
ROCCE MOLTO DURE (es. rocce metamorfiche molto poco fratturate)	1400	1620	-
ROCCE DURE (es. graniti, rocce ignee, conglomerati, arenarie e argilliti, da mediamente a poco fratturati)	700	1050	1400
SUOLI GHIAIOSI e ROCCE DA TENERE A DURE (es. rocce sedimentarie ignee, tenere, arenarie, argilliti, ghiaie e suoli con > 20% di ghiaia)	375	540	700
ARGILLE COMPATTE e SUOLI SABBIOSI (es. sabbie da sciolte a molto compatte, limi e argille sabbiose, argille da medie a compatte e argille limose)	200	290	375
TERRENI TENERI (es. terreni di riempimento sotto falda, argille da tenere a molto tenere).	100	150	200

>$FFRUGLQJ WR WKH 6(6$0([illegible] HIRUH LQWHUS
WKH IROORZLQJ WDEOHV@

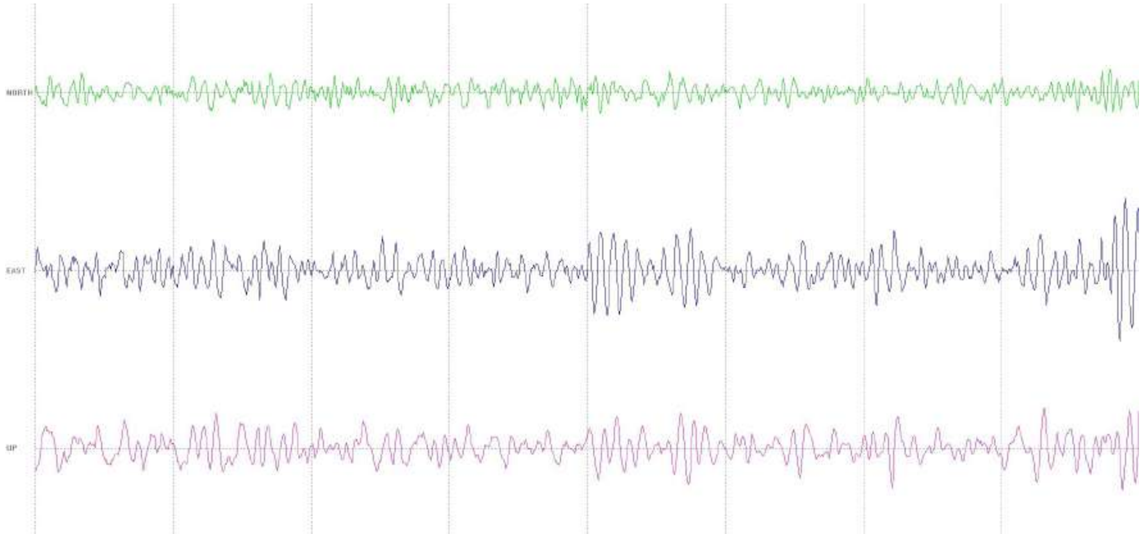
0D[+ 9 DW " +] LQ WKH UDQJH +]

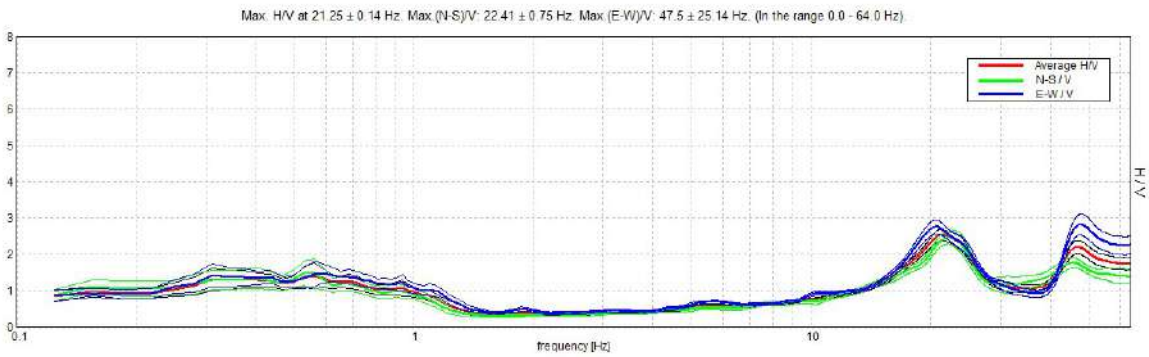
&ULWHULD IRU D UHOLDEOH + 9 FXUYH >$OO VKRXOG EH IXOILOOHG@			
! z	!	2.	
(f !	!	2.	
V$ I IRU II LI !I +] V$ I IRU II LI I +]	([FHHGHG RXW RI	2.WLPHV	
&ULWHULD IRU D FOHDU + 9 SHDN >$W OHDVW RXW RI VKRXOG EH IXOILOOHG@			
([LVW LQ @ +	+]	2.	
([LVW LQ (_ +	+]	2.	
$!	!	2.	
ISH >$ I V$ I @ " I	_ _	2.	
V HI		2.	
V$ I T I		2.	

/z	ZLQGRZ OHQJWK
Qz	QXPEHU RI ZLQGRZV XVHG LQ WKH DQDO\VLV
Qf /z QI	QXPEHU RI VLJQLILFDQW F\FOHV
I	FXUUHQW IUHTXHQF\
I	+ 9 SHDN IUHTXHQF\
Vf	VWDQGDUG GHYLDWLRQ RI + 9 SHDN IUHTXHQF\
HI	WKUHVKROG YDOXH IRU [illegible] VWDELOLW\ FRQGLWLRQ
$	+ 9 SHDN DPSOLWXGH DW IUHTXHQF\ I
$H/V I	+ 9 FXUYH DPSOLWXGH DW IUHTXHQF\ I
I±	IUHTXHQF\ [illegible] $$
I	IUHTXHQF\ [illegible] $$
V$ I	VWDQGDUG [illegible] EH PXOWLSOLHG RU GLYLGHG
VORJ+9 I	VWDQGDUG [illegible] ORJ $
T I	WKUHVKROG YDOXH IRU [illegible] VWDELOLW\ FRQGLWLRQ

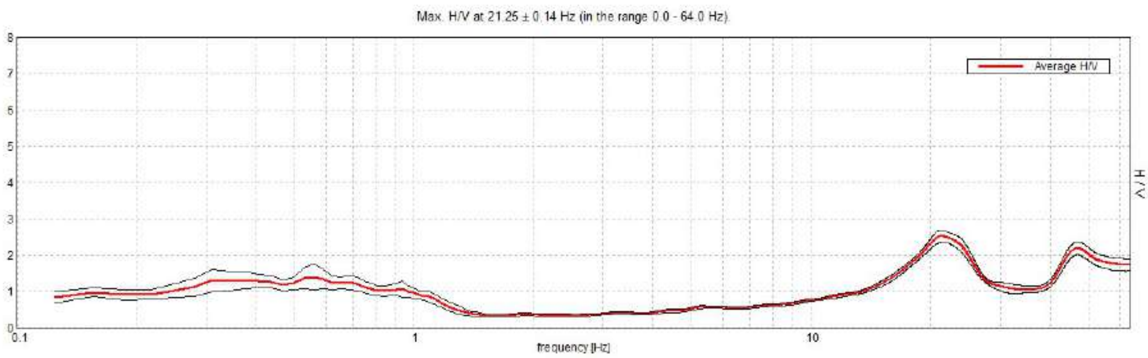
7KUHVKROG [illegible] IRU					
)UHT UDQJH >+]@		±	±	±	
HI >+]@	I	I	I	I	I
T I IRU V$					
ORJ T I IRU VORJ I					

6(55$&$35,2/$)+*965
,QVWUXPHQW 75=
'DWD IRUPDW E\WH
)XOO VFDOH >P9@ Q D
6WDUW UHFRUGLQJ (QG UHFRUGLQJ
&KDQQHO ODEHOV 1257+ 6287+ ($67 :(67 83 '2:1
7UDFH OHQJWK K $QDO\VLV SHUIRUPHG RQ WKH HQWLUH
6DPSOLQJ UDWH +]
:LQGRZ VL]H V
6PRRWKLQJ W\SH 7ULDQJXODU ZLQGRZ
6PRRWKLQJ

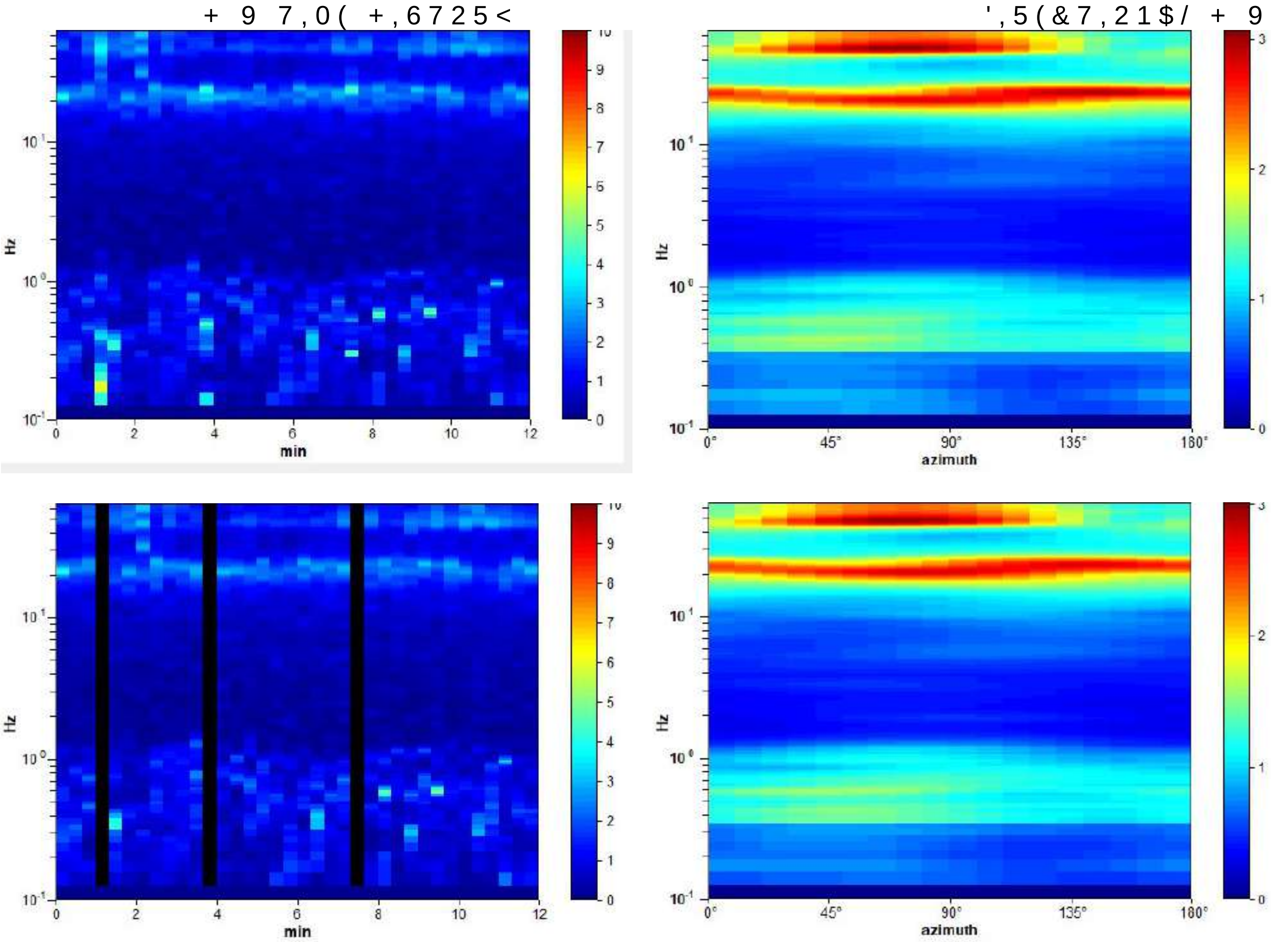




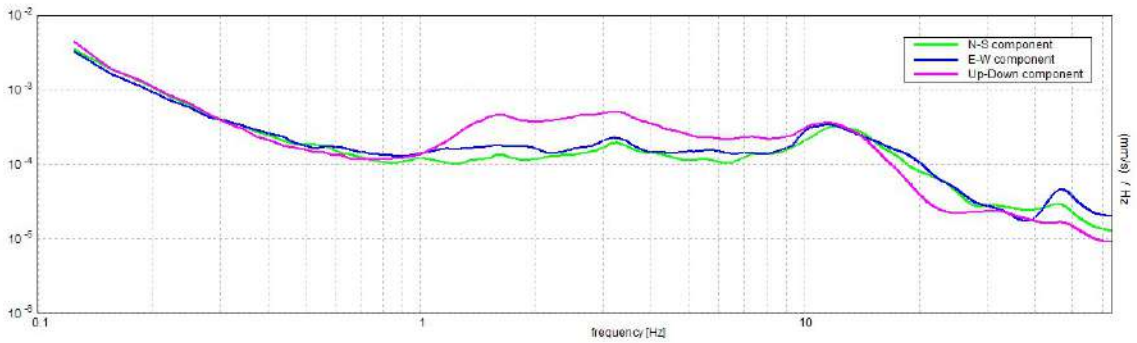
+25,=217$/ 72 9(57,&$/ 63(&75$/ 5$7,2

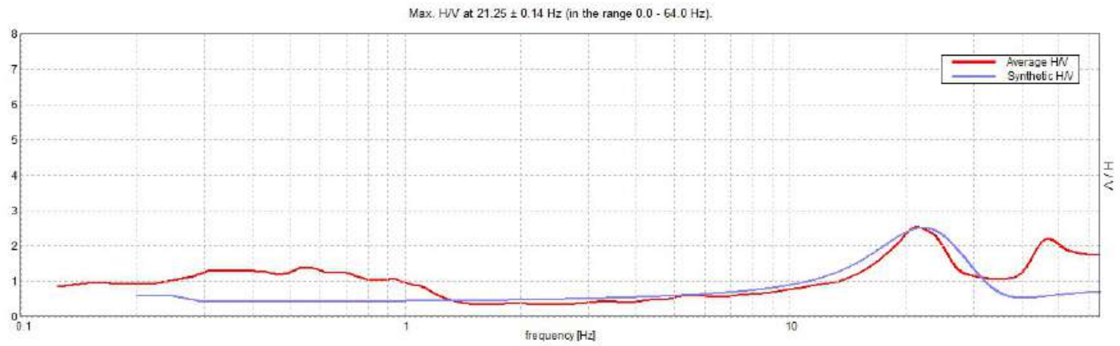


+ 9 7,0(+,6725< ',5(&7,21$/ + 9



6,1*/(&20321(17 63(&75$





02'(//2 '¶,19(56,21(35232672

3URIRQG	6SHVVRUH VLV	9HORFLWj RQGH 9V P V
LQI	LQI	

9VBHT P V

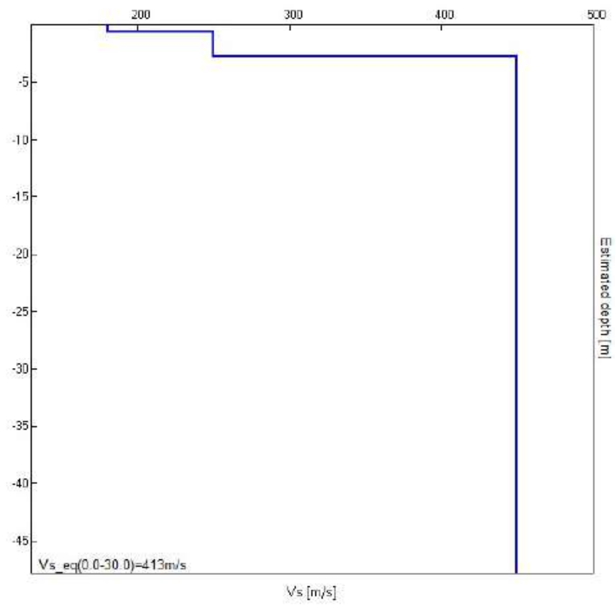


Tabella 1. Velocità caratteristiche delle onde S nei vari tipi di suolo [cfr. Borcherdt, 1994]

TIPO DI SUOLO	V_s min [m/s]	V_s media [m/s]	V_s max [m/s]
ROCCE MOLTO DURE (es. rocce metamorfiche molto poco fratturate)	1400	1620	-
ROCCE DURE (es. graniti, rocce ignee, conglomerati, arenarie e argilliti, da mediamente a poco fratturati)	700	1050	1400
SUOLI GHIAIOSI e ROCCE DA TENERE A DURE (es. rocce sedimentarie ignee, tenere, arenarie, argilliti, ghiaie e suoli con > 20% di ghiaia)	375	540	700
ARGILLE COMPATTE e SUOLI SABBIOSI (es. sabbie da sciolte a molto compatte, limi e argille sabbiose, argille da medie a compatte e argille limose)	200	290	375
TERRENI TENERI (es. terreni di riempimento sotto falda, argille da tenere a molto tenere).	100	150	200

>$FFRUGLQJ WR WKH 6(6$0(3OHDVH LQGLFDWH *UHLOOD DQG WKH EHIRUH LQWHUSUHWLQJ WKH@ROORZLQJ WDEOHV

0D[+ 9 DW “ +] LQ WKH UDQJH +]

&ULWHULD IRU D UHOLDEOH + 9 FXUYH >$OO VKRXOG EH IXOILOOHG@			
! z	!	2.	
(f !	!	2.	
V$ I IRU I I LI !I +] V$ I IRU I I LI I +]	([FHHGHG RXW RI WLPHV	2.	

&ULWHULD IRU D FOHDU + 9 SHDN >$W OHDVW RXW RI VKRXOG EH IXOILOOHG@			
([LVW LQ @ +	+]	2.	
([LVW LQ @ +	+]	2.	
$!	!	2.	
ISH >$ I V$ I @ “ I	_ _	2.	
V HI		2.	
V$ I T I		2.	

/z	ZLQGRZ OHQJWK
Qz	QXPEHU RI ZLQGRZV XVHG LQ WKH DQDO\VLV
Qf / Qz I	QXPEHU RI VLJQLILFDQW F\FOHV
I	FXUUHQW IUHTXHQF\
I	+ 9 SHDN IUHTXHQF\
VI	VWDQGDUG GHYLDWLRQ RI + 9 SHDN IUHTXHQF\
HI	WKUHVKROG YDOXH IRU WKH VWDELOLW\ FRQGLWLRQ
$	+ 9 SHDN DPSOLWXGH DW IUHTXHQF\ I
$+ 9 I	+ 9 FXUYH DPSOLWXGH DW IUHTXHQF\ I
I ±	IUHTXHQF\ EHWZHHQ I DQG IRU ZKLFK $+ 9 I $
I	IUHTXHQF\ EHWZHHQ I DQG IRU ZKLFK $+ 9 I $
V$ I	VWDQGDUG GHYLDWLRQ RI $+ 9 I V$ I LV WKH IDFWRU E\ ZKLFK WKH PHDQ $+ 9 I FXUYH VKRXOG EH PXOWLSOLHG RU GLYLGHG
VORJ+ 9 I	VWDQGDUG GHYLDWLRQ RI WKH ORJ $+ 9 I FXUYH
T I	WKUHVKROG YDOXH IRU WKH VWDELOLW\ FRQGLWLRQ V$ I T I

7KUHVKROG YDOXHV IRU VI DQG V$ I					
)UHT UDQJH >+]@			±	±	±
HI >+]@	I	I	I	I	I
T I IRU V$ I					
ORJT I IRU VORJ I					