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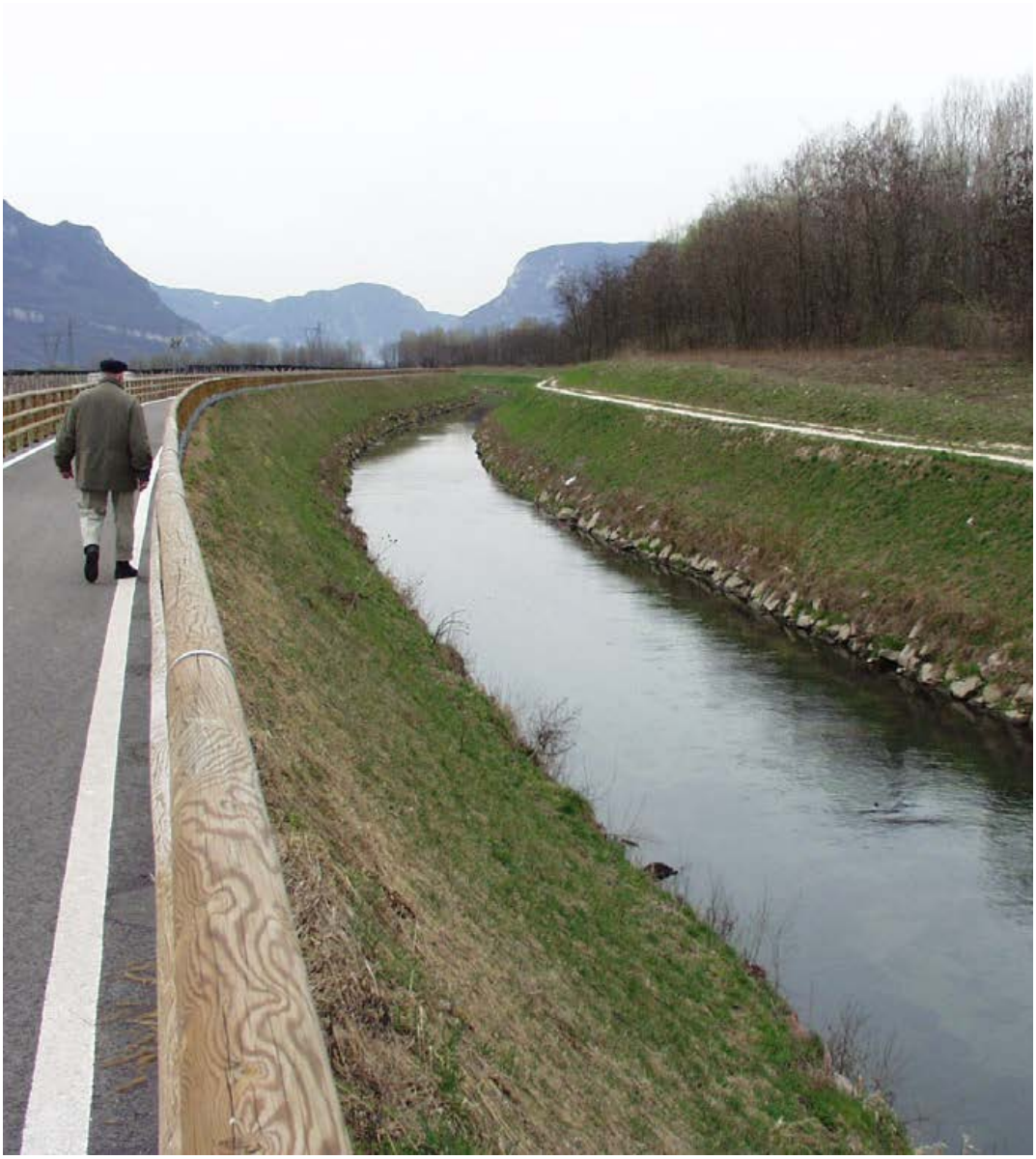
Project Report

Main Drainage Channel - Branzoll

Bozen, South Tyrol/Italy



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Project Data

Contractor	Branzoll Main Drainage Channel Consortium Gerbergasse 24 I - 39100 Bozen
Planning company	Studio Technico - Associato VOLANTE MONTALI Theaterplatz 23/II I - 39012 Meran
Installer	Dept. of Torrent and Avalanche Control for South Tyrol Cesare Battisti Straße 23 I - 39100 Bozen
Assignment	To widen and raise the main drainage channel of Branzoll, including the construction of service roads and cycling trails along both banks, while maintaining existing lateral boundaries
Construction method	Riprapping and Embankment stabilisation with the Krismer System®
Execution period	Autumn 2001 until Summer 2002

Project volume	Total embankment length: ~ 3.600 m (2 x 1.800 m) Reconstruction surface: ~ 18.200 m² Integration of the System Krismer ® into border zones: ~ 5400 m² Embankment inclination: - 45 ° Embankment height: 6 – 6.5 m

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Initial Situation

Due to global climate changes and the increase of severe weather conditions that this has caused, the frequency and intensity of extreme flooding has increased strongly in great parts of Europe during the past years. This also affected the main drainage channel of Branzoll, whose capacity reached its limit to the point that it could no longer lead away excess flood water.

This led to repeated flooding of adjacent farm land and orchards. Furthermore, the embankments of the drainage channel were heavily damaged over time, to the point that access to the channel from above became impossible and maintenance work to the waterway was no longer possible.

Hence, the central task was to enlarge the channel and increase the channel's water bearing capacity according to higher, acceptable calculated water quantities. Consequently the drainage cross section was to be extended in width and height.

The planned inclination of the embankment was approx. 42° - 45°. The final installation was to include surface drainage and the washing-out of fine particles from the embankment was to be prevented as much as possible.

To meet these requirements for optimal embankment stabilisation, the Krismer System® construction method was selected.

Fig. 1: Branzoll main drainage channel before construction work began

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Embankment Stabilisation with the Krismer System® - System Structure

Embankment surface:

(after the slope surface was prepared)

- layer of top soil (thickness ~ 3 cm) with seeds (for the formation of a compact layer of turf)

- Krismer System®: three-dimensional steel grid panel (J.K.S. panel), type J.K.S. A02-80 | 1.5-FEZ, height = 8 cm, fixed with special ground nails (with welded-on hook and point) and strengthened with hot-dip galvanised distribution rods Ø 12 mm, type R12/2500 or R12/3700

- gravel filling (into the three-dimensional J.K.S. panels):
  grain size 32/60 mm, quantity 6 m³/100 m²

- geotextile: width = 4 m, weight 200g/m²

Integration of the Krismer System® at the embankment base (border zone – riprap stone wall / Krismer System®):

- cover net: wire netting, type Maccafferi, mesh size 50/70 mm, wire size 2 mm, galvanised, fastened with steel clips, type Spenax 11 G 40

- sack gabions: Ø 0.5 m, length = 2 m

- geotextile: width = 2 m, weight 200g/m²

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Project Execution

Fig. 2: Widening of the existing riverbed and constructing of the required embankment inclination

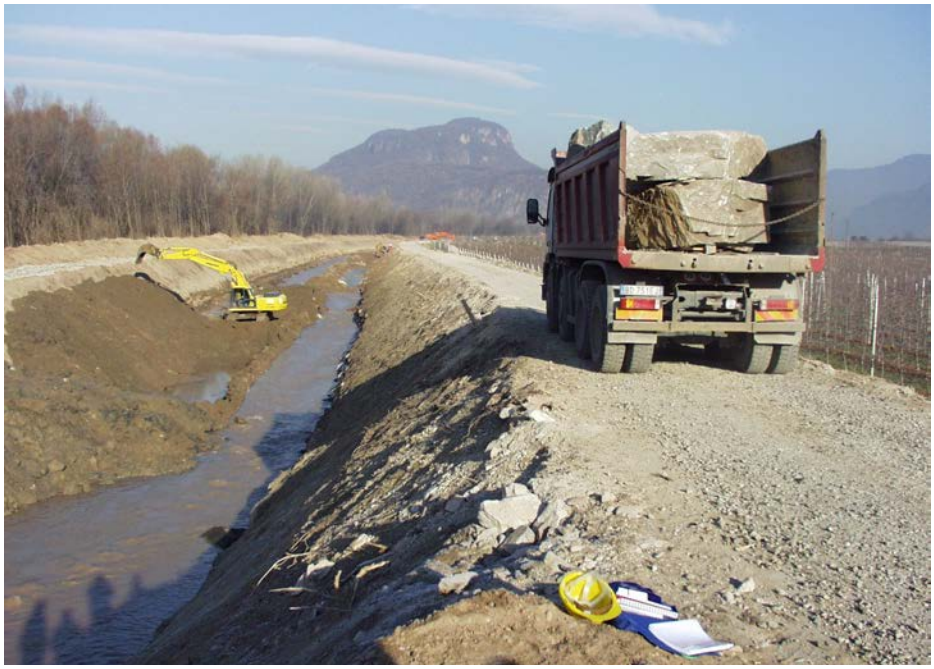

Fig. 3: Delivery of river stones for the construction of a riprap stone wall for the integration of the embankment in the base of the channel

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Fig. 4: Placing of the river stones (riprap)

Fig. 5: Integration of the Krismer System® at the embankment base

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For the integration of the Krismer System® at the base of the embankment a wire net (type Maccaferri, mesh size 50/70 mm, width = 4 m) and a layer of geotextile (weight 200 g/m ², width = 2 m) was laid along the riprap wall. The wire net and the geotextile were weighted down by means of sack gabions (fig. 5)

It was necessary for the wire net to be over-extended a minimum of 2-3 m at the down-hill end, so that it could be folded over and fastened to the Krismer System®, once the three-dimensional J.K.S. panels were integrated behind the sack gabions.

The high load that the sack gabions bear guarantees the full integration of the system between the installation base and the riprap wall.

Sack gabions were also placed along the entire length of the riprap stone wall. These gabons serve the function of preventing possible water erosion of the embankment surface, particularily in the gaps between the coarse stone blocks.

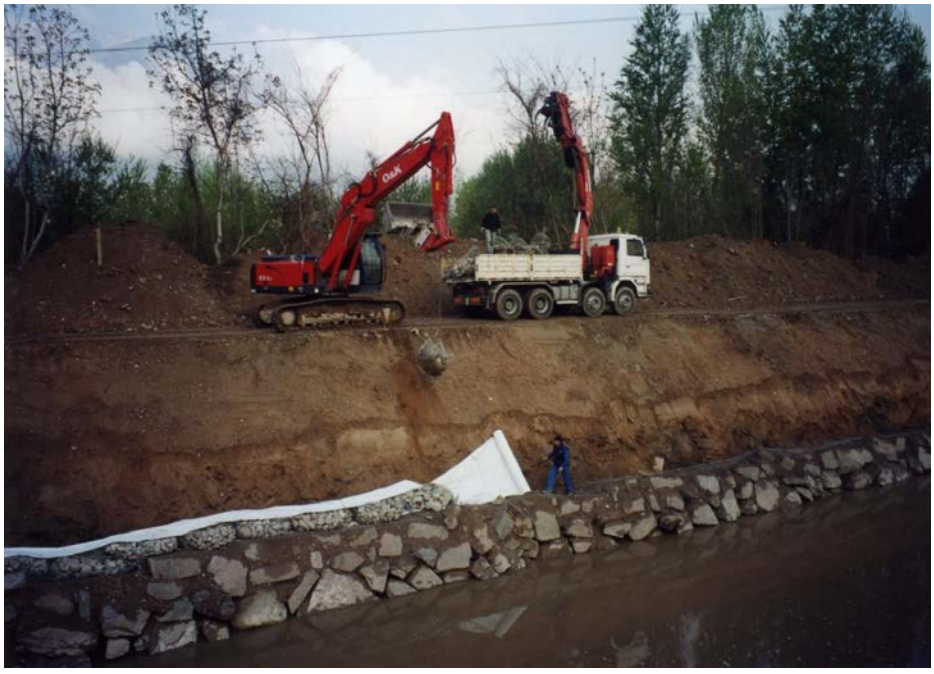

Fig. 6: Wire netting, geotextile and sack gabions were used for the integration of the Krismer System® at the embankment base

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The step-by-step installation of the whole embankment stabilisation system proceeded as follows:

Before installation of the Krismer System®, the embankment surface was cleaned and uneven terrain was back-filled. Then a geotextile was laid on the embankment surface as the system's lowest layer (fig. 7). This serves to prevent washing-out of fine particles.

The rows of geotextile (width = 4 m) were overlapped laterally 20 cm. An extra length of geotextile was left at the base of the slope, to be used later to integrate the system along the embankment.

Fig. 7: Installation of the geotextile on the embankment surface

Immediately after the geotextile was put in place, the installation team started to assemble single J.K.S. panels into larger segments, by overlapping the individual panels longitudinally and laterally and securing with wire binding loops. This was done taking advantage of the flat area above the embankment, which provided a secure, level work space.

These segments were laid on top of the geotextile (fig. 8, 9) and interconnected with stainless steel wire binding loops. It is important to take into consideration the fact that the J.K.S. panels must be placed directly onto the embankment surface diagonally and opposite to the flow direction of the watercourse (fig. 9).

The screen was firmly anchored to the subsoil using special T-steel nails which were rammed into the ground.

To increase the compound action of the Krismer System®, distribution rods were systematically inserted into the J.K.S. panels.

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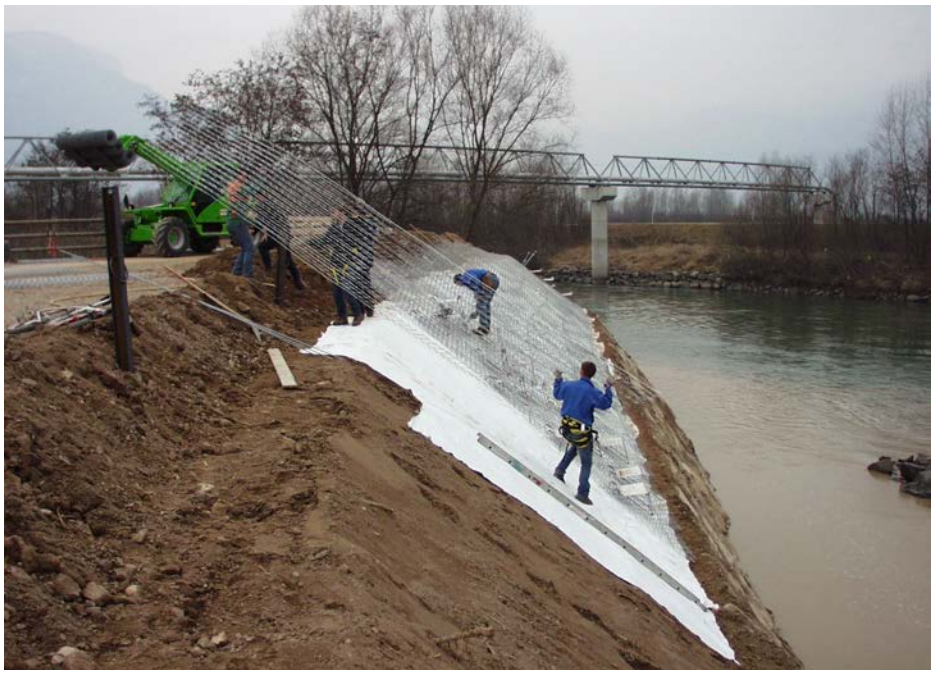

Fig. 8: Installation of the J.K.S. panels, pre-assembled into larger segments

Fig. 9: Laying the segments of the J.K.S. panels crosswise to the fall line of the embankment and against the flow direction of the watercourse

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Ramming the ground nails was done following a defined grid. Nail distribution and length were previously calculated according to static requirements

Fig. 10: Ramming the ground nails

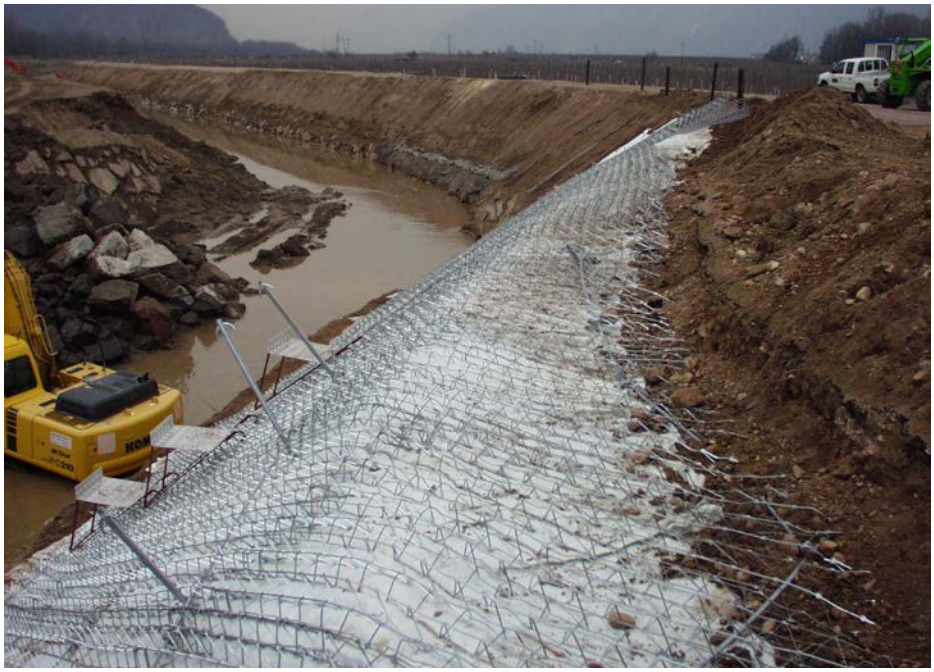

Fig. 11: Integration of the Krismer System® into the adjacent area (top border zone)

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At the crest of the embankment the complete installation was integrated into the border zone to a width of about 1,5 m. along the top slope edge. The J.K.S. panels were fastened with earth nails spaced approx. 1 m apart.

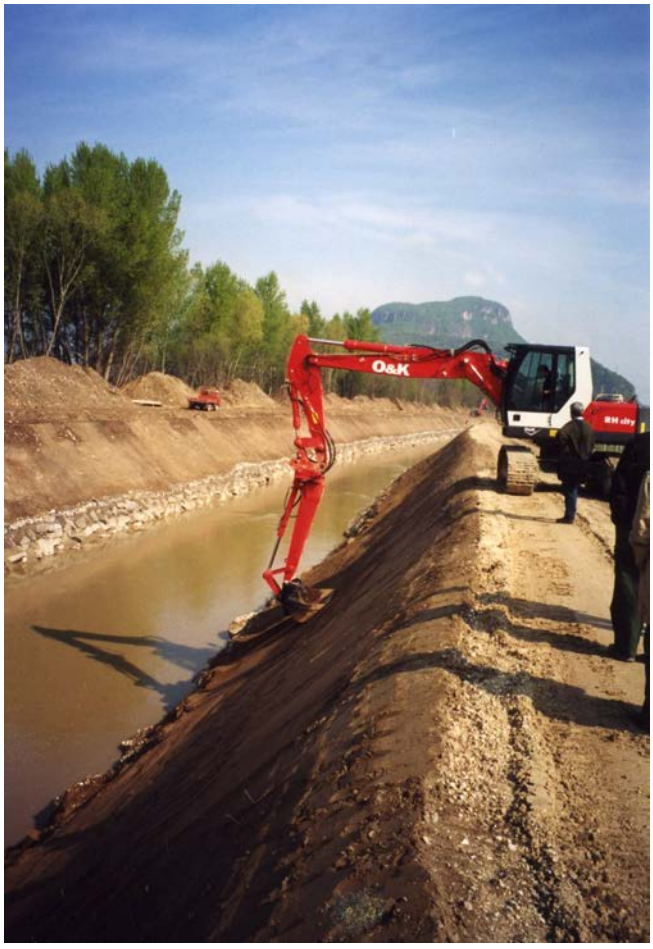

Fig. 12: Filling gravel and humus into the J.K.S. panels with a back-hoe

The application of the Krismer System® for embankment stabilisation enables surface drainage. For this the J.K.S. panels must be filled with crushed gravel (grain size 32/60 mm). This work was carried out with a back-hoe from the top of the embankment.

Later the J.K.S. panels were filled with humus also.

Seeding took place using mineral (quick releasing) as well as biological (long lasting) fertilisers. This serves to accelerate plant growth and enhances quick development of the root base, which serves to additionally strengthen erosion protection.

In this case, the customer opted to decline the installation of the cover net.

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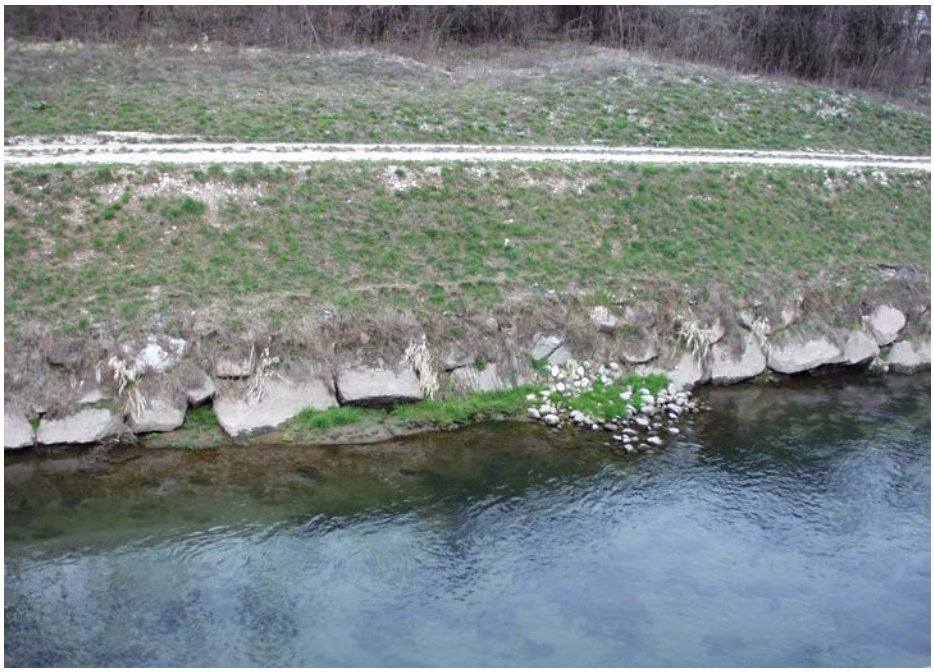

Fig. 13: Embankment stabilisation with the Krismer System® (03/2004)

A year after finishing the construction work a post-fertilisation of the embankment surface took place. This serves to ensure the long term growth of a steady and compact layer of turf (fig.13).

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Results

In the expansion of the Branzoll main drainage channel, the Krismer System® was used for the stabilisation of the embankments on both sides.

To date, the following results can be recognised as a verifiable result of this construction measure:

- sustainable protection of the embankment from erosion
- excellent compound effect and stable construction of the J.K.S. panels counteract flow pressure optimally
- surface stabilisation is water permeable, drains perfectly and prevents a high formation of flow pressure
- the stabilised layer of top soil forms the base for lasting plant growth
- the application of the Krismer System® enabled most favourable embankment stabilisation with an inclination of 45°, which allowed several hectares of valuable landscaped ground to be regained

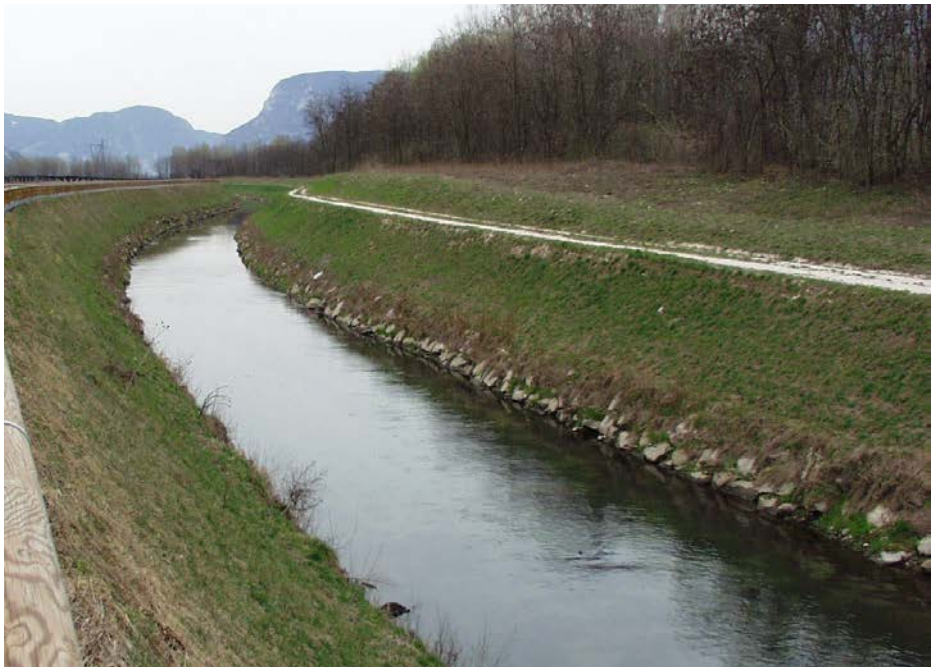

Fig. 14: Main drainage channel - Branzoll (03/2004)