



WWF for a living planet®

Eyes on Tung Chung Stream Restoration

Progress of reinstatement

Background

A stream section of the Tung Chung Stream downstream of Shek Mun Kap had suffered the impact of unauthorized removal of boulders and rocks around the end of 2003. WWF Hong Kong has been invited to the Specialist Group on Tung Chung Stream Reinstatement Work by the Government and has been providing our recommendations on the ecological restoration of the stream. The restoration work has been started since 16 Feb 2004. We have been following the work progress and providing additional comments on-site during our site monitoring visits.

21 November 2003

Our first site visit on Tung Chung Stream after devastation. Please note that a haul road was built on one side of the stream for the access of construction vehicles. The stream was narrowed and straightened. The streambed boulders were also removed and stockpiled on the streamside.



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong

22 & 23 February 2004

After one week of restoration work, about 10 metres of the stream restoration work had been done. However, the pools were somewhat unnatural in appearance and the cobble layers in the riffle sections were too thick. There were also inadequate big boulders randomly placing on the streambed. Comments were given on-site and the contractor was following the recommendations from the Specialist Group to re-shape the stream channel.



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



WWF for a living planet®

Eyes on Tung Chung Stream Restoration

Progress of reinstatement

1 March 2004

About 60 metres of the stream had been done. With the experience of from the first 10 metres and the implementation of the requirements suggested by Specialist Group, the restored stream channels were more resembled to a natural stream. Nevertheless, the Specialist Group did provide some further suggestion, such as the positioning of big boulders to facilitate the formation of pools and the reduction of silt downstream of the work site.



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong

12 March 2004

About half of the devastated stream being restored. The restoration work was generally acceptable, however, the installation of big boulders on and the meandering of the stream channel were inadequate. At the same time, grass was planted on the exposed soil beside the restored stream channel to reduce soil erosion. Some organisms were observed at the restored stream section, including fish (e.g. Half-banded Barb & Swordtail), and spider (*Pisauridae*).



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong

1 April 2004



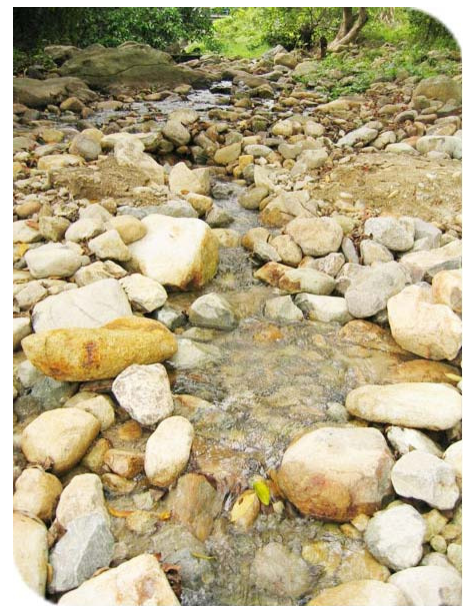
© Alan Leung/ WWF Hong Kong

The restoration of the Tung Chung Stream has been completed.

In terms of the physical environment of the stream, we consider the restoration work is successful because:

- the stream bank and streambed have been stabilized using natural rock particles;
- instream structures, including pools and riffles, have been rebuilt;
- some riparian vegetation, mainly have been replanted or seeded;
- the haul road has been removed; and
- the stream profile and setting is somewhat resemble to pre-disturbed condition.

Although some invertebrates (e.g. mayfly larvae and true fly larvae) and fish (e.g. Parazacco spiliurus, Half-banded Barb & Swordtail) have been returned, the species diversity and abundance have not yet recovered. Whether the biotic communities would be recovered totally is difficult to be estimated but it would be a long-term process. Nevertheless, the Agriculture, Fisheries and Conservation Department has committed to monitor the stream communities at least in the coming few years.



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



WWF for a living planet®

Eyes on Tung Chung Stream Restoration

Progress of reinstatement

29 April 2004

After one month of completion, the environmental conditions of the restored Tung Chung Stream is improving steadily, with the formation of various habitats including sand and leaf litter patches in addition to pools and riffles. By field observation, three species of fish (*Parazacco spiliurus*, Half-banded Barb & Swordtail) and two species of damselfly adults (*Neurobasis chinensis* & *Rhinocypha perforata*) were found. Sampling of benthic invertebrates found that a few species of pioneer insects, including mayfly larvae (*Liebebiella vera* and *Baetis* sp.) and Chironomids, dominated the stream benthic communities.



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



WWF for a living planet®

Eyes on Tung Chung Stream Restoration

Progress of reinstatement

27 May 2004

The stream outlook has changed considerably with the sizes and locations of pools and riffles looked rather different from before! Such modification of the stream setting were possibly induced by the intensified rainfall on 8 May 04, which near 200 mm of rainfall was recorded around the Tung Chung Stream drainage basin. The nature seems trying to re-shape the stream by itself to makes it more "natural".

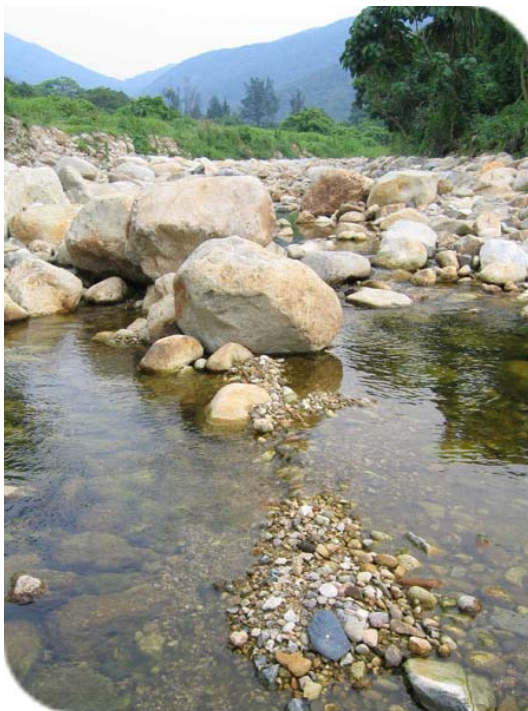
Beside the organisms recorded during the last visit were sighted again, the rare fish, *Acrossocheilus bejiangensis*, was also first appeared in the re-instated stream section. Although it is pre-mature to conclude that this fish with high conservation value has successfully inhabit this stream section since they maybe just wash down by the current accidentally or temporarily, it is indeed a good sign as the sighting suggested that this rare fish is still existing in the stream and their population may still have a chance to re-establish.



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



© Alan Leung/ WWF Hong Kong



Trithemis aurora

© Alan Leung/ WWF Hong Kong



Acrossocheilus bejiangensis

© Alan Leung



WWF for a living planet®

Eyes on Tung Chung Stream Restoration

Letter of concern to the Government
15 December 2003

Urge for Prompt Action on Habitat Restoration of Tung Chung Stream (by Dr. Alan Leung)

World Wide Fund for Nature Hong Kong is gravely concerned about the destruction of the ecologically important Tung Chung Stream, that was due to the illegal collection of stream substrate. **We urge the relevant Government Departments to take immediate actions to restore the destructed stream into its nature state as far as possible before the arrival of the coming wet season (April 2004).**

The stream section between Shek Mun Kap and Shek Lau Po of the Tung Chung Stream supports at least seven species of native fishes, including the *Acrossocheilus beijiangensis* (see the picture on the left hand side) and *Oryzias curvinotus* which are of high conservation value..

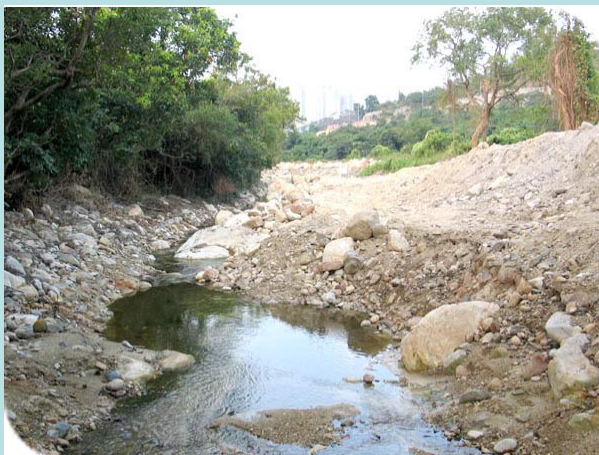
According to my field visit made on 21st November, 2003, the affected section of streams was dominated by sandy substrate. The stream bank on the side between the stream and Tung Chung Road was highly unstable, which were mainly formed by loosely placed cobbles, with all the riparian vegetation removed. Such environment provides no refuges for stream organisms, including fishes, particularly during the period of high water flow after heavy rains. The small sized substrate particles (sand and cobbles) would also be easily carried downstream during high stream flow, directly affecting the downstream Drainage Service Department channelized section of Tung Chung Stream.

We, therefore, recommend:

Gather views from stream ecology experts and green groups on the stream restoration proposal.

Restore the impacted stream section on or before March 2004, providing a one-month buffer period for, by chance, an unexpected early arrival of the wet season.

After the completion of restoration work, conduct regular monthly site monitoring for at least one year to ensure the stream restoration is successful.



© Alan Leung/ WWF Hong Kong

The destroyed River section downstream of Shek Mun Kap



© Alan Leung/ WWF Hong Kong

Natural undisturbed section upstream of Shek Mun Kap.



WWF for a living planet®

Eyes on Tung Chung Stream Restoration

Recommendations to Government
13 January 2004

Recommendations on the Reinstatement Design of the Impacted Section of Tung Chung Stream downstream of Shek Mun Kap (by Dr. Alan Leung)

Background

Around October 2003, an about 330 metres third-order lowland stream section downstream of Shek Mun Kap of the Tung Chung Stream (the Stream) was suffered the impact of unauthorized removal of boulders and rocks (the impact) for the construction of the artificial lake for Penny's Bay Development project (ACE 2003). The Stream supported about 20 species of native freshwater fish (ACE 2003) and at least seven species of native fish, including the *Acrossocheilus beijiangensis* and *Oryzias curvinotus* which are of high conservation value were recorded around impacted section (Chan 2001; Environmental Impact Assessment Report 2002). According to the Information Leaflet - Pebbles and boulders from Tung Chung Stream - published by Civil Engineering Department on 17 December 2003, the Tung Chung Rural Committee (TCRC), which carried out an unapproved flood protection work in the impacted section, should submit a reinstatement plan together programme of works by 24 December 2003 for the restoration of the section. With reference to Agriculture, Fisheries and Conservation Department (phone communication on 24 December 2003), TCRC failed to submit the plan. Since there is an urgent need for the reinstatement of the impacted stream section before the arrival of the coming wet season (around April 2004) to prevent further degradation of the Stream, we would like to submit our recommendations on the reinstatement plan for the ecological restoration of the Stream.

General Consideration on Reinstatement

The physical and functional characteristics of the impacted stream should be restored to its original conditions, in particular its ecological functions, as far as possible.

The illegal constructions, including the haul road and dam, should be removed.

Since the stream morphological information before the impact is unavailable (except for the bird-view site plan), reference should be made from the unimpacted upstream section further up to Shek Mun Kap and the section immediate upstream of Shek Mun Kap.

The morphological characteristics (see below) of the reference sections should be studied and the information obtained should be used for the design of detailed reinstatement site plan.

Reinstatement should include:

- i. stabilization of the stream bank and streambed with the removal of illegal construction;
- ii. rebuilt of instream structure; and
- iii. replantation of riparian vegetation.

The stream and riparian communities should be considered in the reinstatement plan.

During the reinstatement construction, fish and other vertebrates should be translocated upstream of the impacted sites.

The reinstatement work should be completed before April 2004. A contingency plan should be made for delay completion of work.

The biotic communities should be allowed to re-establish naturally after reinstatement.

The stream characteristics and the stream biological community structure should be monitored after the reinstatement.

Stream Morphological Characteristics

The reinstatement work should involve the reconstruction of stream morphology resembling to its pre-impact state. Our suggestions on the stream morphological characteristics to be restored are as follows (see Gordon et al. 1992; Gore et al. 1995; Leung 2002; Mitsch & Jorgensen 2004):

Wet width

Bank full width

Bank full depth

Meandered stream reach

Substrate particle size distribution

Riffle-pool patterns

Special instream features

Recommendations on the Reinstatement Design of the Impacted Section of Tung Chung Stream downstream of Shek Mun Kap (*cont.*)

Suggested Reinstatement Works

Reformation of the Meandering of the Stream Course

- According to the field inspection, the water current speed along the impacted stream section was increased due to the straightened and narrowed stream channel.
- The stream channel should be widened according to the information of wet width, bank full width and depth from the reference sections.
- During the widening, some degree of meandering of stream should be created with reference to the reference sections and the maps showing the pre-impact stream section.
- The Construction should be started from upstream to downstream.

Stabilization of Stream Bank

- A combination of hard and soft bank stabilization techniques (Gore et al. 1995) could be employed, nevertheless, permanent construction features, such as concrete walls or gabions, should be avoided so that natural stream channel evolution is permitted.
- For the stabilization of the stream bank, hard stabilization technique could employ an integration of wooden piles, wooden boards and rock boulders (Federal Interagency Stream Restoration Working Group 2001). The wooden materials were intended to be used as temporary stream bank stabilization purposes before soft stabilization features well established.
- Soft stabilization technique involves the planting of riparian vegetation. This technique should be used for long-term protection of stream bank to take over the wooden materials.
- Immersion tolerant or aquatic local native plants (such as those found in the reference section) should be planted near the water level at base-flow as well as the normal flow during wet season.
- Marginal plants, such as native grasses with individual rhizomes, should be the dominant for replantation. They should be planted near and above the water level at the normal flow during wet season, and the remaining excavated area.
- Native riparian trees should be planted at area along the stream bank with higher water erosion for better stream bank protection. Nevertheless, the number of trees being planted should be compatible with the surrounding habitats and the original stream fauna. For instance, the rare fish used to be found in or near the impacted stream section, *Oryzias curvnotus*, lives in rice fields or similar freshwater wetland, and therefore, trees should not be extensively planted.

Reconstruction of the Streambed and Instream Features

The substrate particle size distribution, riffle-pool patterns and special instream features should be resembled to the reference sections.

The materials used for the construction should be those being illegally removed from the impacted stream.

Positioning of large boulders on the streambed should be used as the skeleton of the reforming of pools and riffles. Parts of the boulders should be buried underground so as to reduce the risk of being moved during spates or high flow associated with heavy rain. After positioning of large boulders, heavy machinery should not be used.

The installation of smaller boulders, stones and cobbles should be made by hand or non-machinery equipment. Guidelines for the positioning the particles should be given to the workers.

Shallow pools with immersed vegetation, backwaters, and other instream features should be constructed at the final stage.

Recommendations on the Reinstatement Design of the Impacted Section of Tung Chung Stream downstream of Shek Mun Kap (*cont.*)

Suggested Reinstatement Works

Monitoring

Detailed survey of the impacted and reference sections should be carried at least once during the middle of the wet and the middle of the dry seasons (Leung 2002). After heavy rains, such as those related to flooding, rainstorm, or typhoon warnings, additional site inspections should be made to note damages on the reinstatement features. Since erosion along the stream course is a natural process, whether repairing works being carried or not should be subjected to the degrees and effects of the damages. The biotic community structure, including fish and macroinvertebrate communities, should be used as indicators for the evaluation of the success of the reinstatement.

For the fish community, the re-establishment of rare fish communities, *Acrossocheilus beijiangensis* and *Oryzias curvinotus*, should be used as indicators as the success. The species richness and composition of fish should be monitored and compared with the pre-impact data from Chan (2001).

For the macroinvertebrate community, species richness should be used as indicator. At least two streams of similar characteristics should be used as control sites.

Stream water chemistry (e.g. acidity and level of pollutants) should be monitored monthly.

Acknowledgement

I would like to thank for the support and comments on the manuscript of this document from Green Power, Green Lantau Association and The Conservancy Association. Thanks also are given to Prof. Dudgeon (Department of Ecology & Biodiversity, The University of Hong Kong) for his comments on the document.

Reference

ACE (2003). *ACE Paper 37/2003 - Unauthorized works at Tung Chung Stream*. Advisory Council on the Environment. Hong Kong S.A.R.

Chan, P. L. (2001) *Sustainability and biodiversity: the impact, alternative design and prospects of restoration of channelized lowland streams in Hong Kong*. Ph.D. Thesis, The University of Hong Kong, Hong Kong: 365 pp.

Environmental Impact Assessment Report (2002) Report No.: *EIA-075/2002 - Improvement to Tung Chung Road between Lung Tseng Tau and Cheung Sha*. Environmental Protection Department. Hong Kong SAR.

Federal Interagency Stream Restoration Working Group (2001) *Stream Corridor Restoration: Principles, Processes, and Practices*. NISR Working Group, Part 653 of National Engineering Handbook. USDA-Natural Resources Conservation Service, Washington, DC.

Gordon, N. D., McMahon, Ta. A. & Finlayson, B. L. (1992) *Stream Hydrology: an Introduction for Ecologists*. John Wiley & Sons: 526 pp.

Gore J. A., Bryant, F. L. & Crawford D. J. (1995) River and Stream Restoration. In: *Rehabilitating Damaged Ecosystems*. 2nd Edition. Cairns, J. (eds). Lewis Publishers, Boca Raton: 245-275.

Leung, S. L. (2002) *Scale-dependent effects of spatial and temporal variability on benthic macroinvertebrate communities in Hong Kong streams*. Ph.D. Thesis, The University of Hong Kong, Hong Kong: 265 pp.

Mitsch W. J. & Jorgensen S. E. (2004) *Ecological Engineering and Ecosystem Restoration*. John Wiley & Sons: 411 pp.

Panel on Environmental Affairs and Panel on Planning, Lands and Works "IMPACT OF CONSTRUCTION WORKS ON RIVERS IN HONG KONG"

Background

Hong Kong streams and rivers support rich biodiversity including large arrays of organisms, including insects, crustaceans, gastropods, bivalves, amphibians, reptiles, fish, and aquatic and riparian plants. Streams and rivers are highly integrated with the surrounding terrestrial environment with the exchange of both organic and inorganic materials. They are important grounds for water, feeding and breeding of many terrestrial organisms.

Hong Kong streams and rivers, however, are also under intense human disturbance, including water extraction, pollution, and structural modifications, such as construction of dams, weirs and channelisation.

The recent incidents, for example, both the illegal devastation in Tung Chung River and legal destruction of concrete lining of two streams at Sai Kung have highlighted the poor coordination among government departments in planning and monitoring construction works in streams and rivers.

Indeed, half of the freshwater biodiversity has been destroyed worldwide in the last 30 years¹.

Freshwater habitats are considered as the most critically threatened ecosystems. Hong Kong, being the "Asia's World City", should protect our streams and rivers to conserve local biodiversity and adhere to the principles of sustainable development.

Suggestions on the Protection of Streams and Rivers

Conservation Authority

Under the current framework, a number of departments under the Environment, Transport and Works Bureau and Housing, Planning and Lands Bureau, including the Drainage Service Department (DSD), Water Supplies Department, Lands Department, Environmental Protection Department (EPD) and Agriculture, Fisheries and Conservation Department (AFCD), are involved in the issues of streams and rivers in Hong Kong. However, incidents mentioned above have clearly demonstrated the ineffectiveness of coordination among these departments. The government should recognize the importance of streams, rivers and their water catchment protection in Hong Kong at the policy level by establishing integrated management and action plans to coordinate the work among various departments. As such, an authority for designing of comprehensive conservation strategies including the remits covering environmental quality, biodiversity and resource management should be set up. This authority should oversee the conservation of biodiversity issues and coordinating sectoral and other aspects (e.g., interdepartmental land and resource use conflict issues, and conservation conflict issues among government departments) of an integrated territorial (including freshwater, terrestrial and marine) biodiversity conservation programme.

Development of sustainable flooding control strategies

The government should develop sustainable flooding control practices. Channelisation should be taken as the last resolve to control flooding impacts. Better land use planning should be adopted to reduce or avoid future development on the flood prone area.

DSD should review the needs and environmental impacts of the existing Drainage Master Plans and individual drainage projects. Unless these projects are of significant public interests, channelisation should be stopped.

In areas where stream channelisation is unavoidable, ecologically friendly design of the stream channels should be used.

¹ WWF (2002). [Living Planet Report 2002](http://www.panda.org/about_our_earth/all_publications/living_planet_report/) WWF International
http://www.panda.org/about_our_earth/all_publications/living_planet_report/.



WWF for a living planet®

Eyes on Tung Chung Stream Restoration

Submission to Legislative Council
23 February 2004

Panel on Environmental Affairs and Panel on Planning, Lands and Works "IMPACT OF CONSTRUCTION WORKS ON RIVERS IN HONG KONG" (*cont.*)

Ecologically Friendly Stream Channel Designs

Although DSD, EPD, Territory Development Department and AFCD have given examples of environmentally friendly drainage channel designs arising from environmental impact assessments in December 1998 (lasted update: March 2002), they are not adequate to protect the most stream organisms.

For instance, the use of grasscrete linings on the stream bank only serve as greening purposes. Although these linings provide habitats to few species of birds and terrestrial insects, they are not useful for stream organisms as they are not immersed in stream water for most of the year. The government should develop Ecologically Friendly Stream Channel Designs with participation of experts in stream or river ecology. The design of the stream channels should support the original biological communities and the original streambed should be preserved, where possible. Reconstruction of instream habitats, such as pools and riffles, should be included when modification of the stream course is unavoidable. Ecologically friendly designs should be adopted as the standard channelisation practices in all public and private projects.

Ecological restoration of degraded stream ecosystem

The government should set up action plans to restore the ecological values of degraded channelised streams and rivers.

Increase of penalty

Illegal excavations of the natural environment, including streams and rivers, should be considered as serious crimes and heavier penalties should be imposed to offenders for deterrent purpose.

WWF Hong Kong calls for a cross-departmental conservation authority to protect Hong Kong streams and rivers. Freshwater habitats should NOT be compromised for the sake of development. The government should adopt a sustainable flooding control strategies with ecologically friendly stream channel designs and restore all degraded river systems.