



LANDSCAPE PERFORMANCE SERIES

Shanghai Houtan Park – Shanghai, China Methodology for Landscape Performance Benefits

Environmental

- ***Cleans up to 634,000 gallons of polluted river water daily, improving the water's quality from Grade V (unsuitable for human contact) to Grade II (suitable for landscape irrigation) using only biological processes.***

According to Jiwei Chen, Cong Wang and Yinjiang Zhang's research on the wetland purification system of Houtan Park, about 660,000 gallons of water are pumped from the Huangpu River daily. Roughly 343,500 gal are discharged back into the river once cleaned, 264,000 gal are used in the water features of adjacent Expo Park, and 26,500 gal of water either evaporate, infiltrate into the soil, or are absorbed by plants.

Water in the river starts at Grade V, the lowest grade given by the Environmental Protection Bureau. It improves in quality to Grade II as it moves through these different cleaning systems:

Stonewall Waterfall Purification: The stonewall waterfall purification is about 200 meters long, with a cistern that is about 200 meters long and about 2 meters high. The water here is Grade IV~V.

Terraced Fields Purification: Water is filtered and cleaned by taking advantage of gravity as the water moves down through the terraces and a "U" pipe connection that traps pollutants, in much the same way a storm water catch basin does. There is also subsurface filtration. The water here is Grade III~IV.

Heavy Metal Purification: This area is ~260 meters long. The main function is adsorption of heavy metals and toxins through plants. All plant material is held and composted onsite so that heavy metals are not distributed. The water here is between Grade III~IV.

Pathogens Purification: This area is ~250 meters long. Here plants absorb excess nitrates and phosphorus from the polluted water. This also helps with plant growth and development. The water here is Grade II~III.

Aeration: In this ~250-meter long area, the water runs through a series of cascading terraces to introduce oxygen back into the water. The water here is Grade II~III.

Water Stability and Sand Filtration: This area is ~300 meters long. The water here is Grade II.

After purification, various water quality data are as follows:

pH 6-9
Ammonia nitrogen < 1 mg/L
Potassium permanganate < 6 mg/L
Five days bod < 4 mg/L
N < 1 mg/L; P < 0.2 mg/L

All research and observations of the wetland purification system at Houtan wetland park were conducted onsite by Haibo Tang, and Tianyuan Yuan of Turenscape Shanghai, and Jiwei Chen,

Cong Wang, Yue Dong and Yinjiang Zhang of Shanghai Ocean University Shanghai Ocean University Research Team.

- ***Reduced Increased the biodiversity of the site dramatically, with 93 species of plants and over 200 species of animals observed.***

According to the statistical data of plants and animals species compiled by Haibo Tang, and Tianyuan Yuan of Turenscape Shanghai, and Yue Dong and Yinjiang Zhang of Shanghai Ocean University, there are over 70 species of aquatic invertebrates, 36 species of woody vegetation, 50 species of herb vegetation, and approximately 7 species of crops. There are also 73 species of aquatic animals, 20 species of birds, 29 species of insects, 2 species of amphibians, 8 species of reptiles, 2 species of mammals, and 2 species of arthropods.

- ***Sequesters an estimated 242 tons of carbon annually in park's extensive wetlands, perennial plantings, and trees.***

The online Tree Benefit Calculator ¹ was used to calculate the total carbon sequestration from 585 mixed trees species throughout the park. 77.6 tons of carbon are sequestered by a variety of tree species including metasequoia, willow, privet, camphor tree etc.

According to the study of Hongyu Wang ²and Guangsheng Zhou³, the carbon fixation of reed wetland is 13.32t/ha, so it's estimated that 38.14 tons of carbon are sequestered in 7.12 acres of reed, 61.9 tons of carbon are sequestered in 9.75 acres of native wetland and 60.3 tons of carbon is sequestered in 6.6 acres of internal river vegetation.

According to Jin Shulan, Zhu Ziming and Xu Caiqiu's ⁴study on carbon sequestration of vegetation, 4.11 tons of carbon was sequestered by 1 acre productive vegetation (wheat: 1.74 tons, rapeseed: 1.18 tons, sugar cane: 0.8 tons and sunflower: 0.37 tons).

$77.6 + 38.14 + 61.9 + 60.3 + 4.11 =$ a total estimate of 242 tons of carbon sequestered per year

- ***Successfully demonstrated state-of-the-art design and construction techniques, resulting in 8 national design patents and 20-30 subsequent ecological water purification projects that employ the techniques created for Houtan Park.***

According to a review of all the projects Turenscape has completed or is undertaking, 20-30 employ the successful techniques created for Houtan Park.

The 8 national design patents are for:

Multifunctional one-piece landscape pavilion; patent number: 201120108825.7⁵

Landscape dock with growing pool, patent number: 201120107577.4⁶

Floating balloon as shade landscape; patent number: 201120109061.3⁷

The roof hanging greening device; patent number: 200920246369.5⁸

Landscape reservoir, patent number: 200920246368⁹,

Rainwater collection device in parking lot, patent number: 200920246366¹⁰,

Rainwater collection device for ditches, patent number: 200920246367¹¹

The roof rainwater collection devices, patent number: 200920246369.5¹²

Economic

- ***Saves \$116,800/year in water costs at the adjacent Expo Park where 264,000 gallons of water treated by Houtan Park's wetland purification system is used in the water features.***

As mentioned in the previous bullet, roughly 264,000 gallons of water are sent and used daily at adjacent Expo Park. $264,000 * 365$ (days/year) = 96,360,000 gallons annually. The cost of water in China is \$0.32 /264 gallons. $(96,360,000/264)0.32 = \$116,800$ in annual savings.

- ***Reduced waste and saved an estimated \$17,300 by reusing 37 tons of steel and roughly 34,000 post-industrial bricks found on the site.***

As the park used to be a factory there were a lot of old materials on the existing site. The primary material reused through several features in the design was steel, which was incorporated in the following elements:

Hanging Gardens:	5.43 tons
Steel panels:	14.72 tons
Imbedded in Pavement:	9.99 tons
Architectural Details:	6.87 tons
Total	37.01 tons

The price of new steel in China is \$730/ton¹³: $37.01 * \$730 = \$27,000$

The price to sell old steel is \$385/ton¹⁴: $37.01 * \$385 = \$14,250$

The total cost saved by using existing structures: $\$27,000 - \$14,250 = \$12,750$

Bricks from old factory buildings on the site were reused to construct 0.25 acres of paving. This is the equivalent of 33,954 bricks, as the size of a red brick is 9.5 by 4.5 by 2 inches. As of 2009, brick prices in China¹⁵ were \$0.135 per brick.

Total saved by reusing bricks: $33,954 * 0.135 = \$4584$

Total savings from reusing bricks and steel: $\$4584 + \$12,750 = \$17,300$

Cost Comparison Methodology

- ***Using natural systems to clean polluted river water has a value of approximately \$131,000/year when compared with the typical cost of treating water at a water treatment plant in China.***

It costs \$0.15 to treat roughly 240 gallons of water at a water treatment center in China. Houtan Park treats approximately 634,000 gallons of water daily.

$(0.15 * 634,000)/240 = \$396/\text{day}$

$\$396 * 365 = \$145,000$ annually.

- ***Reusing steel and bricks found on the site to create the hanging gardens, steel arbors and shade structures, paved areas, and architectural details, saved an estimated \$17,300 in material costs.***

See explanation and calculations under fifth Landscape Performance Benefit.

¹ www.treebenefits.com

² Yan Ming, An Overview of the Potential Role of Reed Wetlands in Terrestrial Carbon Sequestration of China[J]. Chinese Agricultural Science Bulletin, 2010.

³ Zeng Zhao-zhao, Pilot Study on Function and Value of Carbon Storage by Beihai Wetland Ecological System of Tengchong [J]. Environmental Science Survey, 2010.

⁴ Jin Shulan, Zhu Ziming and Xu Caijiu. Study on Carbon Sequestration of Vegetation in Eci-Economic Zone of Poyang Lake[J]. Subtropical Plant Science. 2011, 40(1): 24-27.

-
- ⁵ [http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN201120108825.7&leixin=syxx&title=多功能一体式景观亭&ipc=E04H1/12\(2006.01\)](http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN201120108825.7&leixin=syxx&title=多功能一体式景观亭&ipc=E04H1/12(2006.01))
- ⁶ [http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN201120108825.7&leixin=syxx&title=多功能一体式景观亭&ipc=E04H1/12\(2006.01\)](http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN201120108825.7&leixin=syxx&title=多功能一体式景观亭&ipc=E04H1/12(2006.01))
- ⁷ [http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN201120109061.3&leixin=syxx&title=遮荫景观飘浮气球&ipc=B44C5/00\(2006.01\)](http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN201120109061.3&leixin=syxx&title=遮荫景观飘浮气球&ipc=B44C5/00(2006.01))
- ⁸ [http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN201120091599.6&leixin=syxx&title=%CE%DD%B6%A5%B5%F5%D6%B2%C2%CC%BB%AF%D7%B0%D6%C3&ipc=A01G9/02\(2006.01\)](http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN201120091599.6&leixin=syxx&title=%CE%DD%B6%A5%B5%F5%D6%B2%C2%CC%BB%AF%D7%B0%D6%C3&ipc=A01G9/02(2006.01))
- ⁹ [http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN200920246368.0&leixin=syxx&title=景观蓄水池&ipc=E04H4/00\(2006.01\)](http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN200920246368.0&leixin=syxx&title=景观蓄水池&ipc=E04H4/00(2006.01))
- ¹⁰ [http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN200920246366.1&leixin=syxx&title=停车场雨水收集装置&ipc=E03B3/02\(2006.01\)](http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN200920246366.1&leixin=syxx&title=停车场雨水收集装置&ipc=E03B3/02(2006.01))
- ¹¹ [http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN200920246367.6&leixin=syxx&title=边沟式雨水收集装置&ipc=E03B3/02\(2006.01\)](http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN200920246367.6&leixin=syxx&title=边沟式雨水收集装置&ipc=E03B3/02(2006.01))
- ¹² [http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN200920246369.5&leixin=syxx&title=屋顶雨水收集装置&ipc=E03B3/02\(2006.01\)](http://211.157.104.87:8080/sipo/zljs/hyjs-yx-new.jsp?recid=CN200920246369.5&leixin=syxx&title=屋顶雨水收集装置&ipc=E03B3/02(2006.01))
- ¹³ <http://china.toocle.com/cbna/item/2010-11-11/5487715.html>
- ¹⁴ <http://www.zz91.com/cn/baojia-show975.html>
- ¹⁵ <http://detailp4p.china.alibaba.com/buyer/offerdetail/67464438.html>