The Three Gorges Dam

The dam under construction
The Yangtze River

* Lies along a fault line and was formed approximately 40 million years ago from movement in the earth’s crust.
* The Yangtze is the 3rd largest world river after the Amazon and Nile.
The Yangtze has a troubled history

* Flooding killed over 300,000 in the 20th century.
  - The flood of 1998 destroyed 1/10 of China’s grain supply.
  - A flood in 1996 killed 2,700 people
  - As many as 140,000 people died during a flood in 1931.
The Three Gorges

Qutang - the first of the Yangtze River’s three gorges
The Three Gorges

The Wu Gorge
The Three Gorges

The Xiling Gorge
The Three Gorges Dam

* 1.3 miles wide
* 610 feet high
* The resultant reservoir will be the size of Lake Superior which is nearly 600 km long and has a volume of 10.4 trillion gallons of water.
* The reservoir will cover 58,000 km², an area 16,700 km² larger than Switzerland.
* Construction began in 1994 and was completed in 2008.
  - The final increment of turbines became operational this year
Location of gorges and dam on the Yangtze

Xiling Gorge -- Dam Construction Site
Present and past

![Map image of the area in 1987](image1.jpg)

April 17, 1987

![Map image of the area in 2006](image2.jpg)

2006
More on the Gorges

* The flooded region will encompass the two of the gorges, the Qutang and Wu.
* The Xiling Gorge, downstream from the Wu Gorge, was chosen as the actual site of the dam because its torrential waters show the most promise for generation of electricity.
Total Costs

* The total project has a budget of more than $24 billion dollars.
* Full cost recovery is expected to occur over the next ten years.
Reasons for building the Three Gorges Dam

* Flood control.
* It will produce 18.2 million KW of “clean” electricity
* It will permit increased shipping along the upstream river (river will accommodate larger vessels).
  - The dam includes an elevator that can raise small ships (≈ 3000 tons).
  - And the world’s largest lock system for barges (up to 10,000 tons).
Positive environmental effects

* The power created is equivalent to 18 nuclear power plants or 50 million tons of coal.

* The hydropower generated is equivalent to reduction of future coal-fired atmospheric emissions by approximately 1.2 to 1.3 million tons of CO$_2$ and over 10,000 tons of NO$_x$. 
Flood control

The dam will:
* reduce peak discharge; and
* distribute flow.
However...

The dam also has many potential negative impacts including:
* Inundation & resettlement
* Future flood concerns
* Increased tectonic activity & landslides
* Water pollution
* Sedimentation
* Adverse affects on unique species
Flooding & resettlement

* The reservoir floods 115,000 acres of rich farmland along the river’s banks.
* An additional 54,000 acres of farmland and 17,000 acres of forest are inundated further inland.
  - 320 villages and 140 towns submerged
* 1.3 million people were forced to move, possibly increasing crowding and draining resources in existing cities.
*Days after the first filling of the reservoir, around 80 hairline cracks were observed in the dam's structure. The submerged spillway gates of the dam pose a risk of cavitation, (similar to what severely damaged the spillways of the Glen Canyon Dam in the floods of 1983.*)
* Tectonic activity & landslides

* The dam is built over the fault line that created the three gorges.

* It is possible that the increased weight of the dam and stored water could trigger an earthquake.

* In 2003 when the reservoir was partially filled to a depth of 415 ft. a \( \approx 700 \text{ million } \text{ft}^3 \) rock slide caused 65-ft. waves that claimed the lives of 14 people.

* The large amount of water in the reservoir could create an unprecedented disaster if the dam fails.
Water pollution

* 80% of the current cities along the river did NOT have sewage treatment systems and discharged raw wastewater directly into the river.
  ▪ Over one billion tons of wastewater are released annually into the river.

* Industries along the banks also discharged toxic compounds and waste directly into the river.

* Creating the dam catalyzed improved upstream wastewater treatment. New treatment plants have been created but still don’t meet the total need.
...more on water pollution

* The completed dam will prevent wastes from being flushed downstream and instead trap them in the reservoir possibly creating an extinction zone for the reservoir ecosystem.
  - quality of water in Yangtze is now slowly worsening, due to the dam's preventing dispersal of pollutants; algal blooms have risen progressively since the dam's construction.

* The submergence of some industrial areas will also allow seepage of previously buried wastes.
Still more on water pollution...

* Water released from the bottom of the dam has a low temperature and dissolved oxygen content. By creating a reservoir and regulating river flow, the dam alters the natural rate of reaeration making it more difficult for available oxygen to dissolve in the water. This could have a negative impact on aquatic ecosystems.
*Filling the dam may have caused a water shortage downstream. In Spring 2011 there was a severe drought.*

*400,000 residents of Hubei province lost access to drinking water.*

*Reservoirs in the province lacked inflow.*

*Low water levels near Wuhan closed portions of the Yangtze to ship traffic.*
Sedimentation

* Some sediment will pass through the dam but the time to reach steady state with respect to sediment transport is estimated to be 100 years!

* An estimated 151 million tons/yr of sediment is captured behind the dam.
  
  - The build-up of silt in the reservoir will also create a major reduction in silt transport downstream and erode the alluvial plain.
...a little more on sedimentation

* Bedload, coarse sediment that settles quickly, is another concern at the head of the reservoir.

- Estimates of bedload are approximately 200,000 m³ that will have to be dredged.

* Without dredging, shipping could be hindered and increased flooding upstream is likely.
Adverse species effects

* The Yangtze River is home to two aquatic creatures unique to China...
  ▪ the Yangtze River dolphin
  ▪ the Chinese sturgeon
The Yangtze River dolphin

* The whitefin dolphins are the largest freshwater dolphins in existence.
* They are an integral part of the river food web, and a component of Chinese folklore.
the Chinese sturgeon

* Each fish can live for approximately 80 years.
* They grow to between 4 and 5 m in length.
* They can weigh up to 500 kg.
* These fish have lived in the river since prehistoric times.
* Both the sturgeon and the dolphin are already threatened by current pollution levels.
  - The presence of the dam will likely decrease their numbers.
* There are 177 fish species in the area and 25 are on the endangered list.
* Other animals living along and in the river will also be irreversibly affected (e.g. the Chinese alligator, the finless porpoise, the white crane, several monkey species).
The dam will also affect biodiversity and ecological processes by:

- Immediate loss of habitat.
- Isolation of remaining habitat.
  - Former large habitats have become island patches with reduced species diversity and an altered food web structure.
  - Former mountain tops will have increased accessibility for humans (by boat) which is likely to lead to unprecedented tourism activity.