

# **Xe Bang Fai Cave Development and Management Strategy and Plan**

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## Introduction

The Xe Bang Fai Cave in Hin Nam No National Protected Area (NPA) is a world class cave with great potential for tourism. Hin Nam No NPA encompasses part of a limestone karst area in Boualapha District, Khammouane Province in central Lao PDR, adjacent to the border with Vietnam. The Xe Bang Fai River has cut a 6.4 kilometer (km) underground course through the limestone mountain, creating one of the largest active river cave passages in the world. In addition to the size of the cave passages, the cave is superbly decorated with speleothems, including many large and beautiful stalagmites, flowstone draperies, gour pools and cave pearls.

The Xe Bang Fai Cave is the most significant and distinctive geomorphic feature in Hin Nam No NPA. Thus, it is one of the key features for claiming the outstanding universal value of Hin Nam No as part of a World Heritage nomination. On the other hand, the Xe Bang Fai cave is the most prominent tourist attraction in Hin Nam No, and is seen as a promising source of income for the sustainable financing and management of Hin Nam No NPA, and for improving the livelihoods of the local villagers. Therefore, a careful balance is required between allowing and developing tourism to the cave and protecting the natural heritage features and environment of the cave.

Publicity about the Xe Bang Fai Cave, along with improved access and services has resulted in a rapid increase in visitor numbers in recent years, from less than 100 visitors in 2012 to over 2500 visitors in 2016. In addition, there is growing interest from the private sector in providing tourism services to the cave.

This *Xe Bang Fai Cave Development and Management Strategy and Plan* will regulate the management of the cave and its development for tourism. It was developed to be useful on its own, or in conjunction with the *Master Plan for Tourism Development in the Ban Nongping - Xe Bang Fai Cave Area* [1], which regulates tourism development in the area around, but outside of, the cave.

## Xe Bang Fai Cave Development and Management Strategy

Development Vision: The overall vision outlined in the Hin Nam No Tourism Strategy is: *By 2025 Hin Nam No National Protected Area will connect visitors with local communities through sustainable eco-adventure tourism which contributes to conservation and livelihoods.*

The vision for the ecotourism development of the Xe Bang Fai Cave is: *to develop and manage 'high quality' tourism visitation to areas of the Xe Bang Fai Cave system while protecting and preserving the natural heritage values of the cave.* Cave tours will allow visitors to appreciate and learn about this world-class cave, while providing financial benefits for the protection and management of the Hin Nam No NPA and for the livelihoods of the local community.

The strategy for development and management of the cave is comprised of the following key components:

**Cave Zonation:** In large caves or cave systems, such as the Xe Bang Fai Cave, different areas of the cave are assigned to zones based on the natural heritage values (e.g. geomorphological, biological), sensitivity of these values to human visitation and impact, aesthetic characteristics, and hazards which present safety concerns.

In the Xe Bang Fai Cave there two distinct types of cave passage: the active river passage, and the dry side passages and river terraces situated above the active river passage. Along the active river passage, high-energy annual flooding during the wet season means that the impact of visitors on the cave formations and features of this passage is minimal. On the river terraces and in the dry side passages, situated above the annual flood zone of the river passage, is where most of the large and beautiful speleothem formations occur. These upper areas are much more sensitive to impact and damage by human visitation.

Accordingly, the different areas of the cave system are assigned to one of three zones for protection, development and management purposes: a developed tourism zone, an eco-adventure tourism zone, and a strict protection zone where no tourism or development is allowed. The zonation of the different areas of the cave is detailed in the [Xe Bang Fai Cave Development Plan](#) in the following section.

**Infrastructure Needs:** The purpose of installing infrastructure in a cave is to facilitate visitor satisfaction and safety while minimizing the impact of tourism on the natural heritage values. Infrastructure needs should be carefully assessed, designed and installed. A careful balance is required between the infrastructure required to facilitate access to the cave and the need to minimize alteration or disturbance to the natural environment of the cave. In a prospective World Heritage Site, this balance should err on the side of precaution and conservation [6].

The main infrastructure needs for the Xe Bang Fai Cave are: boats, floating docks, and perhaps some lighting in the developed tourism zone of the active river passage; and walkways with guardrails, and fixed lighting in some of the upper areas of developed tourism zone (e.g. the Balcony Passage). The infrastructure needs for the different areas of the cave are detailed in the [Xe Bang Fai Cave Development Plan](#) in the following section.

**Visitor Management:** Tourism visitation in caves will have some degree of impact, but negative impacts can be minimized and visitor satisfaction can be enhanced by good visitor management procedures and practices. The first step is routing visitor flows into and through the cave. The second step is to define a 'carrying capacity' for the maximum number of visitors per day and the maximum number of visitors in each group, for each of the cave

tours or tourism zones. Regulations for protection of the cave resources and the safety of cave visitors (do's and don'ts) must be developed and displayed. Appropriately trained cave guides must accompany each tour group in the cave. Cave guides are responsible for leading the tours, and ensuring adherence to the regulations for cave protection and visitor safety. Visitor management procedures are detailed in the [Xe Bang Fai Cave Management Plan](#) section.

***Interpretation:*** The purpose of interpretation is to provide information about the cave and its natural heritage values to visitors, to enhance their appreciation and understanding of the cave experience. Interpretive information can also be related to the regulations for cave visitation to enlist voluntary compliance by visitors. Some interpretation information and materials have already been developed for the Xe Bang Fai Cave. Cave interpretation approaches and needs are discussed in the [Xe Bang Fai Cave Management Plan](#) section.

***Baseline Assessment and Monitoring:*** Baseline assessment, survey and documentation of the aesthetic, geological, hydrological and biological resources and attributes of the cave need to be initiated with the assistance of appropriate experts. The results of the baseline assessments will be used to develop recommendations for the development, management and ongoing monitoring of the cave.

***Reporting:*** Regular reporting will be done on the monitoring of cave resources, inspection and maintenance of infrastructure, visitor numbers and visitor management issues. The various reports will be compiled into an annual report with analysis and recommendations for adaptive management response.

## Xe Bang Fai Cave Development Plan

### Cave Zonation

The Xe Bang Fai Cave is currently zoned as one zone (Zone 4: Restricted Use Zone) in the *Master Plan for Tourism Development in the Ban Nongping - Xe Bang Fai Cave Area* [1]. For the scope of this *Cave Development and Management Strategy and Plan*, which encompasses the entire Xe Bang Fai Cave system, three zones or sub-zones are established for the various areas:

- Zone 4a: Developed Tourism Zone
- Zone 4b: Eco-adventure Tourism Zone
- Zone 5: Strict Protection Zone (no tourism or development)

The different areas of the cave are zoned according to the table below:

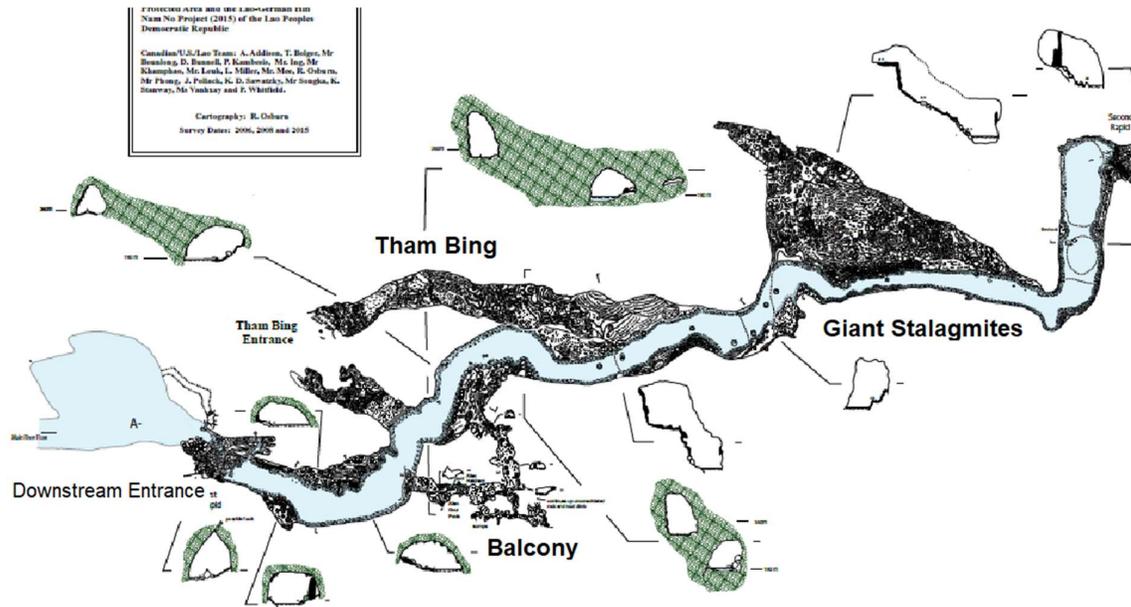
Area of the Xe Bang Fai Cave system	Zone
Lower River: downstream entrance to first rockfall/rapids	4a: Developed Tourism
Balcony Passage	
Tham Bing	
Upper River: upstream of the first rockfall/rapids	4b: Eco-adventure Tourism
Grotte de Nuages: above the upstream entrance	5: Strict Protection
Tham Nguen, Tham Nguen Mai, Tham Pha Pong	

The areas currently open to and/or zoned for tourism (Lower River, Balcony Passage, Tham Bing, Upper River) provide sufficient capacity for the current number of visitors to the cave, and for into the future. The carrying capacity (maximum number of visitors per group and per day) of the different tourism areas of the cave is discussed in the Visitor Management section of the Cave Management Plan.



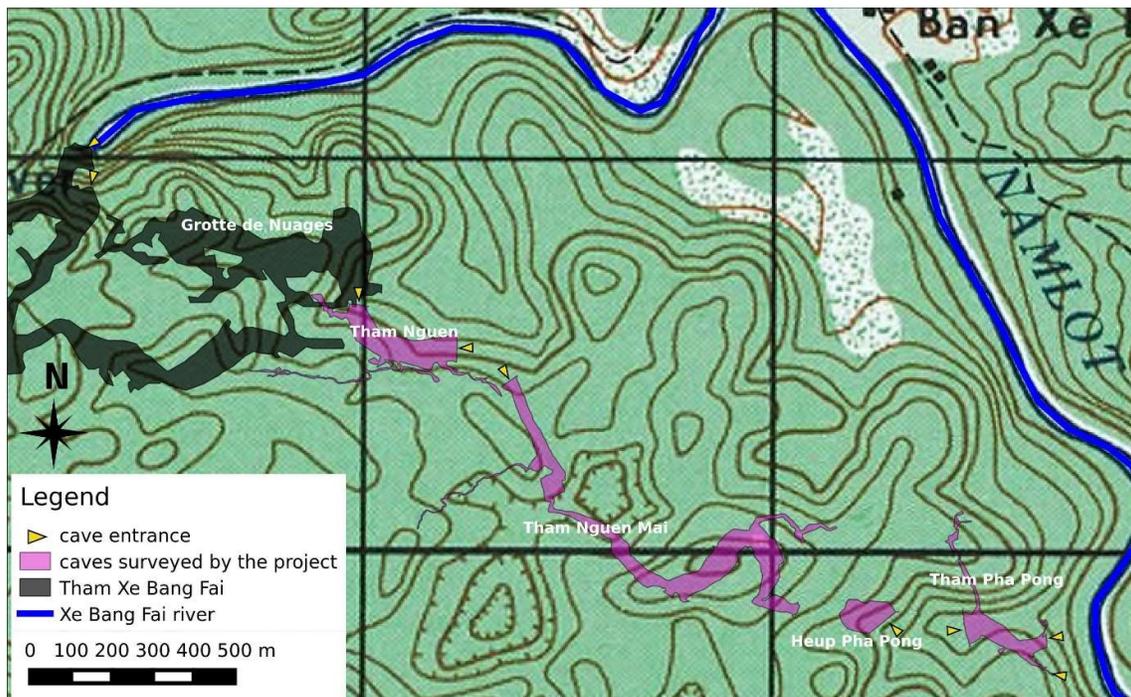
**Figure 1.** Map of the Xe Bang Fai Cave (in black) showing the different zones of the cave.

Tours regularly visit the Lower River, Balcony Passage and Upper River areas of the cave, so these areas of the cave are already 'open' for tourism in practice. The status of the Tham Bing passage for tourism is ambiguous at present. Tours do not regularly visit Tham Bing, but some tour groups do go there. The Tham Bing passage is recommended for limited, restricted tourism only, by both a bat specialist and a cave biology specialist, due to the sensitivity of the biodiversity (particularly *Hipposideros scutinares*, a range-restricted and globally threatened bat species) in this dry, upper section of the cave. Additionally, there are several areas where delicate, white speleothem formations (small gourds and cave pearls) occur on the cave floor and could be easily damaged by regular tourism visitation.



**Figure 2.** Map of the Developed Tourism Zone (Zone 4a), showing the Lower River (in blue), Balcony Passage, and Tham Bing.

Although Tham Bing is zoned as a Developed Tourism Zone (Zone 4a), it will only be opened for tourism under the following conditions: a defined walkway is constructed through the passage (refer to [Infrastructure and Phased Development](#) section), the passage is closed to tourism from March to August (the bat maternity period), and maximum visitor numbers are restricted (refer to [Visitor Management](#) section). Until a walkway is constructed, Tham Bing must be closed to tourism, with HNN NPA responsible for ensuring compliance, in cooperation with the boat service group and private sector tour operators.



**Figure 3.** Map of the cave passages and caves in the upstream area, zoned as Zone 5.

The cave passages and caves (Grotte de Nuages, Tham Nguen, Tham Nguen Mai, Tham Pha Pong) located to the south and east of the upstream entrance of the cave river passage (see Figure 3) are zoned as a Strict Protection Zone (Zone 5), with no tourism or development allowed. These caves and cave passages contain sensitive biodiversity, are hazardous in places, and their remote location makes them difficult to access.

Thus, the entire length of the river passage (6.4 km), the Balcony Passage, and Tham Bing, comprising 7.3 km of the 16 km long cave system, or 46% of the total cave length, is zoned for tourism (Zones 4a and 4b). The zonation provides a rational balance between areas of the cave most suited to tourism, and areas with sensitive fauna and speleothems that should be conserved. Notably, all of the 'world-class' features of the cave are found in the two tourism zones.

Permitted and prohibited activities in each of the zones in the cave are presented in the table.

Zone	Permitted Activities	Prohibited Activities
Zone 4a: Developed Tourism Zone	<ul style="list-style-type: none"> <li>• Guided boat and kayak trips on the Lower River, and guided visits to the Balcony Passage and Tham Bing, subject to the carrying capacity and regulations in the Cave Management Plan</li> <li>• Infrastructure development as specified in this Cave Development Plan</li> <li>• Documentation, monitoring and research activities with permission from HNN NPA</li> </ul>	<ul style="list-style-type: none"> <li>• Motorized boats prohibited</li> <li>• Entering the cave without a guide or permission from HNN NPA</li> <li>• Actions prohibited by the regulations in the Cave Management Plan</li> <li>• No tourism in Tham Bing until a walkway is constructed through this passage (as specified in this Cave Development Plan)</li> </ul>
Zone 4b: Eco-adventure Tourism Zone	<ul style="list-style-type: none"> <li>• Guided kayak trips, subject to the carrying capacity and regulations in the Cave Management Plan</li> <li>• Only minor infrastructure development, as specified in this Cave Development Plan</li> <li>• Documentation, monitoring and research activities with permission from HNN NPA</li> </ul>	<ul style="list-style-type: none"> <li>• Motorized boats prohibited</li> <li>• Entering the cave without a guide or permission from HNN NPA</li> <li>• Actions prohibited by the regulations in the Cave Management Plan</li> </ul>
Zone 5: Strict Protection Zone	<ul style="list-style-type: none"> <li>• Documentation, monitoring and research activities with permission from HNN NPA</li> </ul>	<ul style="list-style-type: none"> <li>• No tourism activities allowed</li> <li>• No development or alteration of the cave environment</li> <li>• Entering the cave without a guide or permission from HNN NPA</li> </ul>

### Infrastructure and Phased Development

Infrastructure needs are mostly confined to the Developed Tourism Zone (Zone 4a) of the cave, with some minor infrastructure required in the Eco-adventure Tourism Zone (Zone 4b). Infrastructure needs and options are described starting from the downstream entrance to the river passage and moving upstream through the cave. The priority or urgency of the various

infrastructure needs is given, so that the infrastructure can be funded and provided in a phased development approach.

#### *Boat Landings at the Cave Entrance and Balcony Passage (High Priority)*

<b>Infrastructure Options</b>	<b>Impact</b>	<b>Cost</b>
1. No boat landing	High	None
2. Boat landing made of bamboo or wood	Low	Moderate
3. Boat landing made of modular plastic	Low	High

A defined boat landing is needed at the downstream cave entrance, where the current walkway meets the cave river, to provide easy and safe visitor access to boats. Currently there is no boat landing, which makes getting on and off the boats congested and difficult for many visitors. The boat landing should be of a floating design to allow for changes in water level during the tourism season (November – May). The boat landing will need to be removed from the cave at the beginning of each wet season and re-installed at the beginning of each dry season. The boat landing will need to be tethered to the cave wall with cables, in a way that allows for water level fluctuations. A similar boat landing is also needed at the staircase to the Balcony Passage, as recommended in the *Hin Nam No NPA Tourism Strategy* [4].

A boat landing made of modular plastic is the recommended/preferred option. The advantages of this option include: quick and easy installation, easy to customize, and robust with minimal maintenance. The cost (delivered to Laos) is about \$140 per square meter.

Modular Floating Dock (10m x 2.5m) = \$3,500 (x 2 docks = \$7,000)

#### *Boats for the Cave Tour (Moderate/Low Priority)*

<b>Infrastructure Options</b>	<b>Impact</b>	<b>Cost</b>
1. Typical Lao river boat, no motor	Moderate	Low
2. Typical Lao river boat, gas motor	High	Moderate
3. Larger stable boat, no motor	Low	Moderate
4. Larger stable boat, electric motor	Low	High

Currently there are 8 typical Lao river boats being used for cave tours, which is the maximum number allowed, based on the carrying capacity for this zone (refer to [Visitor Management](#) section). However, boats which are wider (more stable) and with higher sideboards than the typical Lao river boat are required for international visitors, who are generally larger and less agile than Lao people. Boats should be built and maintained to a good standard for visitors: no water leakage, a larger than normal seat area, and fitted with an elevated rack to keep visitors bags dry. Also, painting the boats would make them look nice for tourists. These boats would be used for tours up the main river passage to the major rockfall located 1.75 km into the cave (Zone 4a). Motorized boats are not permitted to be used inside the cave.

Larger stable boats (x8): ~\$3,600

#### *Guardrail and Walkway in the Balcony Passage (High/Medium Priority)*

<b>Infrastructure Options</b>	<b>Impact</b>	<b>Cost</b>
1. Guardrail, no walkway	High	Low/Moderate
2. Guardrail, concrete walkway	Moderate	High
3. Guardrail, stainless steel walkway	Low/Moderate	Very High

Currently there is a concrete staircase from the river bank up to the Balcony Passage. Along the Balcony Passage there are guardrails made of galvanized steel posts with nylon cord running between the posts. In some places the guardrails define a walkway, while in other places the guardrails only cordon off speleothem formations with no clearly defined walkway. While the guardrails have been effective in limiting visitor impacts, upgrading the guardrails with more suitable and higher quality materials, and to create a clearly defined walkway is a high priority. Many of the steel posts have lost their galvanized coating and are rusting. The guardrail on the concrete staircase up to the Balcony Passage needs to be assessed for possible upgrading also.

Stainless steel guardrails are often recommended as ‘best practice’ in cave development. Guardrails made of precast concrete, made to look like timber or bamboo are another acceptable option. However, galvanized steel is specifically not recommended for use in caves, as the corrosion and leaching of galvanized coatings can have adverse impacts on invertebrate cave fauna and on calcite deposition.

Visitors currently walk on the natural surface of the cave floor along the Balcony Passage. In some places this may be acceptable, but in other places there are delicate speleothem formations on the passage floor, such as the ‘Dragon Eggs’ (Figure 4). Careful assessment, planning and construction monitoring by experts in cave walkway design and installation, and cave resource and heritage management will be required of any walkway development in this passage. While infrastructure such as walkways and guardrails are intended to protect the cave from visitor impacts, the installation of the infrastructure itself can cause major impacts if not done carefully.



**Figure 4.** The Dragon Eggs in the Balcony Passage.

Stainless steel, elevated walkways are often recommended as ‘best practice’ in cave development. However, concrete is still much more widely used as a walkway surface in caves. Mixing and pouring concrete in a cave must be done with great care to minimize impacts. Pre-cast concrete ‘pavers’ are an alternative to mixing and pouring concrete and have been used in caves elsewhere. The best solution for a passage such as the Balcony Passage may be the use of different materials in different areas. For example, the use of concrete for much of the length, a stainless steel walkway in the area of the Dragon Eggs, and perhaps pavers or even the natural rock floor in some areas.

Guardrail alone: ~\$40,000

Walkway with guardrail: ~\$150,000

*Guardrail and Walkway in the Tham Bing Passage (High/Medium Priority)*

Infrastructure Options	Impact	Cost
1. Guardrail, no walkway	High	Low/Moderate

2. Guardrail, concrete walkway	Moderate	High
3. Guardrail, stainless steel walkway	Low/Moderate	Very High

A defined walkway with a guardrail is required in the Tham Bing Passage before it is open to tourism. In parts of this passage there are delicate speleothem formations on the passage floor, such as white calcite rims and cave pearls, which will likely require a stainless steel walkway and guardrail. In other parts of the passage a concrete walkway or even the natural rock floor may be acceptable. Careful assessment, planning and construction monitoring by experts in cave walkway design and installation, and cave resource and heritage management will be required for any walkway development in this passage.

Walkway with guardrail: ~\$300,000

**Cave Lighting (High/Medium Priority)**

Infrastructure Options	Impact	Cost
1. Typical spotlight for guide	Moderate	Low
2. High output spotlight for guide	Low	Moderate
3. Fixed lighting system in cave	Moderate/High	High

As caves are naturally dark places beyond the entrance zone, some form of lighting is required to see anything inside the cave, both to appreciate the cave features and for safety reasons (i.e. to see where you are going).

Portable, battery powered lighting is the most feasible option, at present, for lighting the cave. High-output, modern LED lights (>1000 lumens) are required for tourists to be able to see and appreciate the large passages and speleothem formations in the cave. High-output LED lights that are powered by rechargeable lithium-ion batteries are available for about \$200. Guides in each visitor group must have a powerful LED light to illuminate the large cave passages. In addition, regular headlamps or handheld flashlights must be provided to each tourist for safety purposes.

In the future, when tourist numbers (or revenue) increase substantially, it may become feasible to install fixed lighting in some areas of the Developed Tourism Zone. The two areas where fixed lighting may be considered are in the Balcony Passage, and the Giant Stalagmites on the terrace above the river, further upstream (see Figure 2 map and Figure 5 photo). In the Balcony Passage, brighter lighting could be used to illuminate some of the speleothem formations to be highlighted, while low intensity lighting ( $\leq 10$  lux) could be used to illuminate the walkway for safety purposes. The Giant Stalagmites on the river terrace could be illuminated so that they could be viewed from the boats on the river below.



**Figure 5.** The Giant Stalagmites on a terrace above the river.

Other than the Giant Stalagmites on the terrace, a fixed lighting system along the lower river passage is likely not suitable or feasible. From the beginning of the dark zone up to just before the Giant Stalagmites, there are many bats roosting on the roof and walls of this passage. The fixed lights required to light this passage would need to be bright, which would disturb the bats and cause declines in the bat populations, and possibly even abandonment of this passage as a roosting site. Flooding during the wet season would make the installation and maintenance of a fixed lighting system along this section of passage technically challenging and difficult.

A specialist cave lighting designer will need to be contracted to design and provide the specifications and costs for any fixed lighting to be installed in the cave. LED lighting fixtures specifically designed for the harsh cave environment are available and should be used. All components of the lighting system should be waterproof. The cave lighting designer will also need to be involved in the installation of the lighting system, as proper installation is as important as having the right equipment specifications.

High output LED flashlights (x10): ~\$2,000  
 Fixed lighting, Balcony passage: ~\$60,000  
 Fixed lighting, Giant Stalagmites: ~\$50,000

*Pathway in the Gours Area (High Priority)*

Infrastructure Options	Impact	Cost
1. No defined pathway	High	None
2. Pathway defined by reflective markers	Low	Low

The Gours are located on a terrace alongside the river in the Eco-adventure Tourism Zone (Zone 4b) of the cave, about 3.5 km upstream of the downstream entrance. As the Gours are speleothem formations on the cave floor, they cannot be viewed from kayaks on the river below. To view the Gours, visitors must walk up to the terrace and walk on some small gours on the way.

Currently there is no single, defined path to walk up to a viewpoint and no indication of where to stop or where not to walk. Until recently, very few people have visited this area deep in the cave. However, as kayak trips through the cave are becoming more frequent, there is concern for the impact on the Gours from visitors walking on them. In this area, visitors must only walk to the edge of the Giant Gour (Figure 6), and not walk around and beyond it. Beyond the Giant Gour there are even more delicate formations on the cave floor that visitors should not walk on.



**Figure 6.** The Giant Gour in the Gours area.

A pathway defined by reflective markers is needed to confine visitor traffic and impact to a small area. A pathway about 1 meter wide could be defined by reflective markers with studs on each side of the pathway, cemented into the cave floor with epoxy resin. This would be an effective, low maintenance and low-cost solution to this emerging impact. As the Gours are in the eco-adventure tourism zone with fewer visitors, a pathway defined by reflective markers and guides to keep people on the pathway is considered sufficient to protect this area.

Reflective markers: ~\$2 each

## Xe Bang Fai Cave Management Plan

### Visitor Management

Tourism visitation in caves will have some degree of impact, but negative impacts can be minimized and visitor satisfaction can be enhanced by good visitor management procedures and practices. These include routing visitor flows, determining the maximum tourist numbers (carrying capacity) for the different zones of the cave, having trained cave guides to accompany each tour group in the cave, and regulations for cave visitors to abide by for the protection of the cave and the safety of visitors (do's and don'ts).

#### Visitor Flows

Routing the visitors from the entry point to and through the cave is an important mechanism for visitor management. Visitors purchase tickets at the ticket office and are then led to the cave by the cave guide(s). Visitors are not allowed to enter the cave without a guide. For the Lower River and Balcony Passage there is the option of a 1 hour or a 2-3 hour tour. The 1 hour tour goes up the river passage by boat to the point where a staircase leads up to the Balcony Passage. Here the visitors and guide(s) walk up the staircase and along the passage until it overlooks the river passage. Then they return to the boat and back to the cave entrance. The 2-3 hour tour goes up the river passage by boat as far as the first rockfall / rapids. On the way back downstream it stops to visit the balcony passage before returning to the cave entrance. During Pi Mai Lao, only the shorter 1 hour tour will be offered to accommodate the large visitor numbers during this special period. To regulate visitor flows, a maximum of 8 wooden boats are permitted to be used for tours in the Lower River Passage.

#### Carrying Capacity

A first step to managing visitor numbers is to define a 'carrying capacity' for the maximum number of visitors per day and the maximum number of visitors in each group, for each of the cave tours or tourism zones. The carrying capacity for each area of the tourism zones is given in the table below, and was determined from a consideration of the impacts of visitors on the cave resources and providing a high-quality cave experience for higher-spending visitors.

Zone / Area	Maximum visitors per group/visit	Maximum groups/visits per day	Maximum visitors per day
Zone 4a: Lower River Passage	<ul style="list-style-type: none"> <li>12 visitors maximum per group (assuming that all groups will also visit the Balcony Passage)</li> <li>1 guide paddler per boat</li> <li>3 visitors per boat maximum, 6 boats per group maximum</li> </ul>	<ul style="list-style-type: none"> <li>1 group every hour</li> <li>9 groups per day (8am – 4pm)</li> </ul> <p>Exception for Pi Mai Lao:</p> <ul style="list-style-type: none"> <li>1 group every ½ hour</li> <li>18 groups per day</li> </ul>	<ul style="list-style-type: none"> <li>108 visitors maximum per day</li> </ul> <p>Exception for Pi Mai Lao:</p> <ul style="list-style-type: none"> <li>216 visitors maximum per day</li> </ul>
Zone 4a: Balcony Passage	<ul style="list-style-type: none"> <li>12 visitors maximum per group</li> <li>1 guide for every 1-6 visitors. 2 guides for 7-12 visitors.</li> </ul>	<ul style="list-style-type: none"> <li>1 group every hour</li> <li>9 groups per day (8am – 4pm)</li> </ul>	<ul style="list-style-type: none"> <li>108 visitors maximum per day</li> </ul>

Zone 4a: Tham Bing Passage	<ul style="list-style-type: none"> <li>• 6 visitors maximum per group.</li> <li>• 1 guide for each group</li> </ul>	<ul style="list-style-type: none"> <li>• 1 group every 2 hours</li> <li>• 4 groups per day</li> </ul>	<ul style="list-style-type: none"> <li>• 24 visitors maximum per day</li> </ul>
Zone 4b: Upper River Passage	<ul style="list-style-type: none"> <li>• 12 visitors maximum per group</li> <li>• 2 tour guides with every group</li> </ul>	<ul style="list-style-type: none"> <li>• 4 groups per day (e.g. 4 groups of 9 pax, or 3 groups of 12 pax)</li> <li>• At least 1 hour between groups</li> </ul>	<ul style="list-style-type: none"> <li>• 36 visitors maximum per day</li> </ul>

### *Cave Guides*

Appropriately trained cave guides must accompany each tour group in the cave. The number of cave guides required for each tour and group size is presented in the table above. Cave guides are responsible for leading the tours, and ensuring adherence to the regulations for cave protection and visitor safety. Cave guides can also provide interpretation information about the cave, where shared language(s) allow. Cave guides are required to record and report to HNN NPA the number of visitors on each tour, any incidents that occurred in the cave, damage or breakage of speleothem formations, or any disturbance of bats or swiftlets in the cave from the tour.

Cave guides can be members of the boat service group of Nongping village or employees of a private sector company with a concession for cave tours. All cave guides are required to receive training on: knowledge of the cave and its environment for protection and interpretation purposes, the regulations for cave visitors, guiding tourists through the cave and service standards, and safety issues such as water rescue and first aid. Cave guides must be certified by the Boualapha District Department of Information, Culture and Tourism.

### *Regulations*

Regulations for protection of the cave and the safety of cave visitors (do's and don'ts) must be displayed at the tourist information center, and each tour group must be briefed on the regulations by the cave guides before entering the cave. Persons violating the regulations are subject to punishment under applicable laws of the Lao PDR. The regulations are:

1. Visitors must stay together in a group and within site of the cave guides.
2. Visitors must be provided and wear life vests when on boats in the river passage.
3. Stay on the defined pathways or walkways and do not climb over guardrails.
4. Do not smoke, burn flares or candles, build fires or throw rubbish in the cave. Take all rubbish out of the cave with you.
5. Do not disturb, capture or kill bats, birds, or other animals you may see in the cave. This means no shining bright lights on the bats/birds or making loud noise in areas where they are roosting on the ceiling or walls of the cave. The main areas where bats/birds are roosting are in the Tham Bing passage, and the Lower River passage, from the downstream entrance of the cave up to the terrace with the Giant Stalagmites (Figure 5), including where the Balcony Passage overlooks the river. Swiftlets and bats should not be disturbed at any time of the year, but it is very important not to disturb the bats from March to August. During this time the female bats are giving birth and raising their babies. If disturbed they will drop their babies into the water or onto the rocks below, and the baby bats will die.

6. Do not walk or climb on, touch, pick up, break or steal the speleothem formations in the cave, such as the stalagmites, stalactites, flowstone, or cave pearls. Walking on or touching can damage the formations, or stop them from continuing to grow.
7. No food or flavored drinks are allowed on tours to Tham Bing, the Balcony Passage or the Lower River passage. Only water in a plastic bottle is allowed.
8. In the Giant Stalagmites area of the Lower River passage (Figure 2), people must not get out of the boats or kayaks and walk around up on the terrace with stalagmites. The floor of this area is delicate, and the stalagmites can be viewed from the river (Figure 5).
9. In the Gours area of the Upper River passage, people can only walk to the edge of the giant gour, following a defined pathway, and must not walk around and beyond it (Figure 6). The floor of this area is delicate and impacted by foot traffic.

## Interpretation

The purpose of interpretation is to provide information about the cave and its natural heritage values to visitors, to enhance their appreciation and understanding of the cave experience. Interpretive information can also be related to the regulations for cave visitation to enlist voluntary compliance by visitors.

Some interpretation information and materials have already been developed for the Xe Bang Fai Cave. These interpretation materials are displayed at the tourist information center. However, the regulations for cave visitors (see above) also need to be printed and displayed at the tourist information center or at the ticket office. Interpretive signs can also be placed in the Balcony Passage of the cave, near features to be highlighted. Interpretive displays will be in Lao and English languages, at least.

Appropriately trained cave guides can also provide interpretation information about the cave, where shared language(s) allow. Interpretation provided by the cave guides is especially desirable along the upper and lower river passage, where it is not possible to place interpretive signs.

## Maintenance of Infrastructure

All infrastructure in the cave must be designed and installed so that it is robust and has low maintenance requirements. Cave infrastructure must be inspected, and maintained as required, at the beginning and end of the dry season, at least. For example, boats and floating docks must be removed from the cave at the beginning of the wet season and placed back in the cave at the beginning of the dry season, making these convenient times for inspection and maintenance. If possible, infrastructure should be inspected and maintained one time per month during the dry season. In addition, cave guides can report any faults or infrastructure maintenance needs that they notice while on cave tours. Some maintenance is routine. For example, the lenses of cave lighting fixtures need to be cleaned of dust and dirt at least once per month during the dry season. Light fixtures which are burned out need to be replaced promptly.

## Baseline Assessment and Monitoring

Conducting baseline assessments, followed by ongoing monitoring of the cave resources, are essential to ensure that the management of the cave is effective. Baseline assessment of the cave fauna was conducted in 2016 [3]. However, a baseline assessment of fish and other aquatic animals in the cave river is still needed [5]. Assessment and photo-documentation of the baseline condition of geologic features in and around the cave, especially speleothem formations, must be established as a high priority, especially in the areas visited by tourists. Baseline measurements of water flow and water quality of the Xe Bang Fai River in the cave also need to be established as a high priority.

On-going monitoring will be undertaken as frequently as necessary to assess the impacts of cave tourism and upstream development, and the effectiveness of management measures.

*Speleothem Formations:* Photo-documentation and monitoring of speleothem formations along cave tour routes, especially the 'Dragon Eggs' in the Balcony Passage (Zone 4a), and in the Gours area (Zone 4b) must be done once per year. This can be done by HNN NPA staff using a camera mounted on a tripod with a flash, following a protocol and using the same position and settings to obtain the same photograph each year. Sequential photographs can then be compared to determine if any impacts are occurring or have occurred. During the dry season, cave guides will report any damage they have seen occur or noticed during cave tours. Then HNN NPA staff will need to photo-document the reported damage.

*Cave Fauna:* An expert in cave biology has proposed [3] that the swiftlets and bats roosting near the downstream cave entrance, in the lower river passage and in Tham Bing may provide a sensitive indicator of tourism impacts on the cave fauna. For other areas of the cave, the cave huntsman spider (*Heteropoda steineri*) and cave crickets were recommended as indicator species for monitoring. Objective measurement of the populations of these indicator species would require commissioning experts using specialized techniques. The cave biology expert proposed that HNN NPA staff or cave guides could monitor these indicator species by making subjective estimates of population sizes at regular intervals [3]. A cave biology expert needs to be commissioned to develop clear protocols for monitoring the cave fauna, and undertake this monitoring and/or train HNN NPA staff and cave guides to monitor the cave fauna.

*Water Quality and Water Flow:* Experts will be required to make baseline measurements and recommend monitoring protocols for water quality and water flow in the cave. Water quality is the key issue in protecting the cave ecosystem. Water flow or water level measurements are required for the appropriate design and placement of infrastructure in the cave, and for determining the water level above which cave tours become unsafe and need to be suspended. Appropriate experts or expert teams may be found at the Department of Meteorology and Hydrology, the National University of Lao, the Mekong River Commission, or the International Water Management Institute.

*Limits of Acceptable Change:* If recognizable variation to measured baseline conditions occur, then maintaining the integrity of the ecosystems and geological features in and around the cave must take precedence over tourism or upstream development [6]. In areas showing recognizable impacts of tourism, the routing or management of the tours will need to be modified to reduce impacts to acceptable minimal and sustainable levels. The terraces alongside and above the river and the side passages, where many of the speleothems occur, are more sensitive to the impacts of tourism on the geoheritage values. In the Tham Bing Passage and along the Lower River Passage, where many swiftlets and bats roost, is the area most sensitive to the impacts of tourism on the cave fauna.

## Watershed Management

Water quality management of the entire catchment area providing water to the Xe Bang Fai Cave is the key issue to protecting the cave ecosystem, and also the greater karst ecosystem, as limestone karst ecosystems are especially susceptible to the impacts of water quality and pollution [6]. An extension of the Hin Namno NPA boundary to include the headwaters of the Xe Bang Fai has previously been proposed on this basis [5]. If this is not possible, due to the large catchment area upstream of the cave (1300 km<sup>2</sup>), then it is critical that a cooperative management plan for the upper catchment area of the Xe Bang Fai be negotiated and implemented between the Hin Namno NPA, other relevant government departments, and the local communities. Such a plan will need to regulate land use and land use change in the upper catchment area, and activities such as logging, mining and agriculture which impact on water quality. An additional concern, in this regard, is that the western boundary of Hin Nam No NPA is the Xe Bang Fai River itself, rather than the surface watershed divide or the edge of the karst to the West (surface and subsurface watershed divides are not always in alignment in karst areas). For most of the current area of the Hin Namno NPA, extending the boundary about 2-3 km to the southwest, as has been proposed previously [5], would include the western edge of the karst or the western watershed boundary of the Xe Bang Fai into the NPA.

The natural forest vegetation in the area above the cave must also be protected to maintain the quality of the water infiltrating into the cave from above. Forest on karst is particularly vulnerable due to the shallow soils and rapid drainage, and even a small degree of initial degradation can cause a downward spiral of ecological conditions leading to a condition known as rock desertification, a rocky landscape almost devoid of soil or vegetation, from which forest recovery is virtually impossible [2].

## Reporting

Regular reporting must be done on the monitoring of cave resources, inspection and maintenance of infrastructure, visitor numbers and visitor management issues. The HNN NPA will be responsible for overseeing all reporting, but may enlist the support of other TWG members and the private sector in collecting information. For example, cave guides could be enlisted to provide a short report form on each cave tour giving: visitor numbers, observations on cave fauna, speleothem formations, infrastructure, and visitor behavior. Reports from regular infrastructure inspection and maintenance could involve the TWG members and the private sector. Reports from monitoring of cave fauna, speleothem formations, water flow and quality would need to be done by HNN NPA staff or with the help of experts in these fields. The HNN NPA should be responsible for compiling the various reports into an annual report with analysis and recommendations for adaptive management response.

## Roles and Responsibilities of Stakeholders

Except for the private sector, the stakeholders involved in tourism and management of the Xe Bang Fai Cave are members of the Hin Nam No Tourism Working Group (TWG) for Ban Nong Ping. Individual responsibilities are described here and summarised in the following table. It is important that each member of the TWG has a clear role to play. Some roles overlap but one member of the TWG must be the lead. It is important that members of the TWG work together and consult each other frequently and other external stakeholders, such as the private sector, Khammouane Provincial Government, GIZ, NGOs or other actors.

*Hin Nam No NPA:* The HNN NPA is responsible for the protection and management of the Xe Bang Fai Cave, including coordinating, managing and monitoring all tourism activities within the cave. It is also responsible for ensuring that tourism activities comply with relevant environmental and conservation standards and regulations contained in this plan. This includes leading all activities related to the cave, including assessment and monitoring, development and management of the cave resources for recreational tourism, education or scientific research.

*Bualapha District Department of Information Culture and Tourism (DICT):* The DICT is the district authority on tourism, reporting to the District Governor. Its main responsibility is to manage tourism development in the district. This includes taking the lead on district marketing and promotion, granting tourism licenses (including for cave guides), enforcing industry standards and training for local people working in tourism. As the Xe Bang Fai Cave is entirely located within HNN NPA, the DICT will play a support role to the HNN NPA in managing tourism inside the cave itself. In particular, the DICT will be involved in cave guide training on service standards and safety.

*Boat Service Group (of the Nongping Village Co-management Committee):* The boat service group of the Nong Ping Village Co-management Committee (VCMC) is responsible for conducting tours in the lower river and Balcony Passage areas of the Developed Tourism Zone of the Xe Bang Fai Cave (Zone 4a). Thus, the boat service group plays a vital role with how visitors interact with the Xe Bang Fai Cave. The boat service group must work in a shared lead role with the Hin Nam No NPA on tourism activities taking place in Zone 4a of the cave. In the future, it is anticipated that the boat service group will upgrade and conduct these cave tours in partnership with the private sector. The boat service group reports to and is coordinated by the VCMC. The VCMC is responsible to coordinate and monitor such collaborations and represent the boat service group in negotiations with the HNN NPA.

*Private Sector:* The private sector may become involved in leading tours to areas of Zones 4a and 4b of the Xe Bang Fai Cave through concession agreements. Through concession agreements or contracts, the private sector may also become involved in the financing and installation of infrastructure in the cave, as indicated in the Cave Development Plan. In these capacities the private sector may share the lead with the HNN NPA. The private sector can play a support role to the HNN NPA in other aspects of the development, management and monitoring of the Xe Bang Fai Cave. In the future, it is anticipated that the private sector will play a joint lead role in conducting tours in the cave.

The table on the following page summarizes the respective roles and responsibilities of TWG members and the private sector.

Tasks / Functions	ROLE OF TOURISM WORKING GROUP MEMBERS AND PRIVATE SECTOR			
	HNN NPA	Bualapha DICT	Boat Service Group	Private Sector
<i>Product development and infrastructure within the XBF Cave</i>	L	S	S	LL
<i>Operation and maintenance of visitor services and facilities in the XBF Cave</i>	L	S	LL	LL
<i>Capacity building on guide training, service standards, safety</i>	L	LL	S	S
<i>Provision of information on the XBF Cave (brochures, signs, video, social media)</i>	L	S	S	S
<i>Enforcement of regulations and standards</i>	L	LL	LL	LL
<i>Baseline assessment and monitoring</i>	L	S	S	S
<i>Reporting</i>	L	S	S	S

**L = Lead organisation**

**S = Support organisation**

**LL = The Lead is shared, depending on what has been agreed between the organisations**

## Capacity Development Needs

Skills for developing and managing the Xe Bang Fai Cave are currently very limited. More training for all members of the Tourism Working Group is required. Private sector tour operators will also require education and training in the regulations concerning cave development and managing tourism contained in this report. The training activities need to be strategically selected, developed and delivered to enable the stakeholders to fulfill their roles. Capacity development needs include:

- Education and training of all TWG and private sector personnel on the global significance of the Xe Bang Fai Cave and World Heritage status, the cave ecosystem, and the need to preserve and protect the resources of the cave.
- Training of relevant HNN NPA staff and cave guides (including in-cave training) on the cave zoning, cave regulations, interpretation, and making observations to assist monitoring of the cave and maintenance of infrastructure.
- Tourist guiding techniques and training for cave guides.
- Basic English language training.
- Training relevant HNN NPA staff and private sector on the inspection and maintenance of infrastructure in the cave. Their roles.
- Training relevant HNN NPA staff on monitoring the cave fauna and speleothem formations.
- A study tour for relevant HNN NPA staff to a cave/karst World Heritage site in Asia. The most relevant site is probably the Gunung Mulu National Park in Sarawak, Malaysia. Another relevant site is the Trang An Scenic Landscape Complex in Vietnam. Both of these are karst sites with caves and cave tours.

## Summary of Costs

An overview of the estimated costs for the cave infrastructure development, maintenance, and monitoring of the cave resources mandated by this plan is presented in the table below. For the infrastructure the capital cost is given. The cost of maintaining the infrastructure is on an annual basis. The cost for monitoring the cave resources is also on an annual basis.

Item	Estimated Cost
Boat Docks	\$7,000
Larger Boats	\$3,600
Walkway in Balcony Passage	\$150,000
Walkway in Tham Bing	\$300,000
High Output LED Flashlights	\$2,000
Fixed Lighting	\$110,000
<i>Subtotal for Infrastructure</i>	<i>\$572,600</i>
Maintenance (annual cost)	\$30,000
Monitoring of Cave Resources (annual cost)	\$12,000
<b>Grand Total</b>	<b>\$614,600</b>

## References

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