Comments on the Environmental Impact Assessment for the Gandak River Waterway No. 37 prepared by EQMS, India Private Limited, Delhi, India.

General Comments to the Chief Wildlife Warden, Bihar Department of Environment and Forests.

Reviewers: Prof. Sunil K. Choudhary, T. M. Bhagalpur University, Bhagalpur
Dr. J. Krishnaswamy, Mr. Nachiket Kelkar & Mr. Tarun Nair, ATREE, Bangalore

1. The Gandak river in India, downstream of the Tribeni barrage, is one of the most biodiversity rich and unpolluted rivers in India and is globally and nationally significant for its breeding populations of the highly endangered *gharial* and the *Gangetic dolphin* besides *fresh-water turtles*, *birds*, and *artisanal fisheries*. The river channel and its habitat such as sand bars, sand banks and islands as well associated riparian vegetation including grasslands and forests are habitat for tigers, rhinoceros and Indian Wolf. These facts have been well documented and described in detailed studies and observations. The Gandak River must be prioritized for biodiversity conservation. The Gandak river, in spite of hydrologic regulation and abstraction of water, is still able to maintain remarkable biodiversity and ecosystem services and any major perturbation such as dredging and channelization is likely to destroy its fragile aquatic ecosystems. The report has ignored the proximity of key breeding and basking sites of the *endangered gharial* to proposed sites for establishment of terminals and sites for dredging. The report shows poor knowledge of basic zoology, ecology and conservation.

2. Keeping in mind the above facts, and our detailed comments on the EIA report below, we propose that the Gandak case must be treated at a special level – different from all other similar rivers in the Gangetic plains of Bihar. This river has not only exceptional and fragile ecological values, it is one of the rare examples where critically endangered species are persisting alongside human use. It is the fifth breeding site of gharials in the wild, anywhere in the world. It has the only relatively *wild floodplain grassland stretches* left in Bihar and has some of the probably last occurrences of the Indian Wolf in Bihar. In this context, the Bihar Forest Department should consider protecting a large section of the river through active intervention (e.g. Conservation Reserve / Community Reserve or "Gharial Reserve).

3. In this context, we would here like to direct the attention of the Chief Wildlife Warden, Bihar Forest Department, to the exemplary response by Madhya Pradesh government on the Chambal River (National Chambal Sanctuary), which was also earlier designated as NW No. 24. The Madhya Pradesh government stated that no intervention of this nature can be allowed in the river, due to the importance for crocodile conservation (as stated in the Rajya Sabha Standing Committee Report on the National Waterways Bill, 2015). Cascading dams on the Chambal are crucial for the region's irrigation, and due to this the MP government pointed out that waterways development will meet with strong public resistance. The case of the Gandak River valley is not very different – with sugarcane crops and factories being strongly dependent on canal irrigation.

4. In general, while the EIA makes a good effort to compile data from multiple sources, and also to collect primary data systematically, there remain *multiple major limitations particularly in relation to their assessments of aquatic ecology, biodiversity, and underwater noise impacts.* Our comments on these sections should be considered in light of these limitations, or incorrect / unfounded statements on the project impacts.

Specific Comments (page-wise)

Page 1. Table 1 – Chainage length total is given at 295.6 km (also in many other places)

Comment: Details are needed on the sources used to calculate this length for NW-37. According to recent maps (2010 onwards) the river length is at least over 320 km, depending on the braided channel tracked for measurement. Not only that, the bathymetric data reported in this report itself (pages 39-41) shows depth data taken across 320 km. This discrepancy needs to be clarified, as many measurements depend on accurate estimation of length of waterway. This discrepancy hinges on all measurements and calculations made throughout the paper, and needs to be addressed.

Page 1. 2.0 Project Need

Comment: The cost effectiveness and environmental soundness are only touted in relation to other existing modes of transportation. However, it would be fallacious to assume at the outset that all practices pertaining to waterways are environmentally sound (especially when one considers dredging, constructions etc.). There are major debates on this subject in developed as well as developing nations, and the portrayed image of waterways as environmentally benign has now been heavily debated. The EIA states the prospect of 'unmatched capacity expansion' without any basis for such an opinion. Given that there are clear physical and environmental limits to expansion of any form of infrastructure, this statement is not acceptable at the outset of the report, without the evidence or sources provided. Clearly, one needs to identify options for environmentally sensitive, and optimal scaling of waterways development based on the available current and future limits/baselines of the ecosystem, to accommodate / buffer the impacts of such expansion.

This sentence in the paragraph is incomplete: "Transportation especially for bulk and containerized cargo Infrastructure requirements of IWT in comparison to road." Many examples of such incomplete or unclear sentences exist in the report.

Page 1: 2.0 and 3.0 (Project Need and Location of Project)

Comment: The environmental soundness and friendliness of waterways expansion depends on a range of factors, some of which may not even be directly within the ambit of the waterways project also. So, we would suggest that until those factors have been thoroughly reviewed, such a statement at the outset creates the impression that it has been assumed that the project will be environmentally friendly.

Page 2. Table 2.

Comment: There is insufficient information on "Maintenance Dredging". The amount of shoal and dredging estimates need to be described better here to put them in context of environmental impact.

Page 2: 5.0 Salient Environmental Features of the Gandak Waterway NW-37

Comment: Throughout the EIA, there is no mention of the Sohagi Barwa Wildlife Sanctuary, parts of which lie along the Gandak river floodplain (where the river flows through the Maharajganj and Kushinagar districts) and are under the jurisdiction of the Uttar Pradesh Forest Department. This is

an important Protected Area for this region and overlaps with the proposed Gandak waterway. Hence this is a serious omission.

Pages 3 & 4: Paragraphs related to Impacts on riverbank and river bank structures due to dredging and barge operations (A-B).

Comment: The following facts may be considered throughout the EIA, especially in relation to impacts of dredging and vessel / barge movements on bank erosion and sediment fluxes:

1. Dredging: Currently small-scale CSD (1350 CAT CSD) dredging is ongoing at Dhanha-Ratwal bridge and near Rajwahi. The purpose of the dredging was to create a different side-channel for diverting river flow for flood control. Dredging crew stated to us during informal interactions (when we had halted near Dhanha-Ratwal bridge in the middle of our gharial survey) that they had multiple difficulties in dredging the river, because of the high sediment flux received at these sites during the monsoon period. The unpredictable braiding behaviour of the river also complicates the effectiveness of dredging, according to the crew.
2. In such circumstances, it is important to critically revisit many assumptions made while taking dredging decisions or during estimation of dredging needs.
3. It may be noted that the Gandak River has the highest erosion rates among all Himalayan rivers of the Ganges basin. This means that natural bank erosion itself is not likely to be negligible in the very least. This also means that wave action due to barges or slippage of sediment layers due to dredging effects might definitely increase erosion rates.
   (Reference: Singh, S. K., S. K. Rai, and S. Krishnaswami (2008), Sr and Nd isotopes in river sediments from the Ganga Basin: Sediment provenance and spatial variability in physical erosion, J. Geophys. Res., 113, F03006, doi:10.1029/2007JF000909.)

Pages 3 & 4: 6.1 C. Impact on river bank & river bank structures due to barge operations: "... Impacts are anticipated to be minimal. ..."

Comment: Has this been ascertained through any data or calculations on wave energy that accounts for substrate type, expected wave height, and wave period?

Page 4. (D) Impacts on air quality are anticipated to be positive

Comment: How can impacts of barges / dredging be positive on air quality? Positive impact should be an improvement in air quality, which is of course not expected.

Page 4. (E) Impact of noise levels.

Comment: In the Key Mitigation Measures section, the first sentence says “Regulation of the dredging operations between 6:00 am to 10:00 pm only”. Dredging is seldom carried out after dusk. Ideally, dredging, if it must be done, needs to be restricted to a few hours every day.
We have provided detailed comments on dredging noise and impacts in later sections.

Page 6.1.1. Impact: last line.

Comment: Sentence is incomplete: “Noise generation from dredger is 160-180 d(B) and behavioural disturbance criteria for dolphins, fishes and another aquatic fauna”. In addition, the threat of habitat loss/alteration/destruction due to maintenance dredging has not been listed.

Page 4, 6.1.1. Key Mitigation Measures: "Restricting dredging in biological sensitive locations and during breeding & spawning season of fishes and migratory bird season may minimize the impact on aquatic fauna significantly."

Comment: This statement assumes that breeding and spawning season of all fishes is the same. However, at least 3 distinct periods are known for river fishes: December-March, March-May, and June-October. The predominant breeding season is in the June to October period (i.e. the high water season), however the fishes that are most harvested in the Gandak river (e.g. Chepua, Aspidopariya morar) is a dry-season breeder, with multiple breeding peaks between December to March-April. The migratory bird season begins in November. For endangered species of high conservation priority: the breeding season for gharials from courtship to hatching extends from November to June, i.e. the entire length of the dry season. For dolphins, the calving period peaks at the lowest water level during the peak dry season (March-June). It is important to explicitly recognize that dredging is most needed during the dry season, and so impacts on these species are likely to be serious. Further, dredging can have harmful effects on non-breeding animals (injury, stress, etc.) that might eventually affect their breeding success. *So, dredging impacts need to be assessed in a more scientific manner than just finding options based on incomplete assumptions.*

Page 6, 8.0. Conclusion & Recommendations.

1. No forest land is involved with the project hence no Forest clearance is required.

Comment: This does not appear correct, because the waterway abuts Valmiki Tiger Reserve and also cuts through and along a part of Sohagi Barwa Wildlife Sanctuary. The river has a highly dynamic course and is known to undergo westward channel shifts –thus the extent of floodplain varies from year to year and therefore does include forestland. Moreover, the definition of "forest" according to the Wildlife Protection Act, Government of India (1972) and later amendments includes 'grasslands, wetlands, etc." which are all part of the Gandak floodplain. Even forests, grasslands, and wetlands not notified as protected area are under the purview of this definition. Not only that, the Gandak grasslands are a key component of the Terai Arc landscape. They are home to endangered terrestrial wildlife that includes species such as the Indian Wolf (not mentioned in the report). They also act as a regular monsoon-time dispersal corridor for Tigers and Greater One-horned Rhinoceros (*Rhinoceros unicornis*) in the Terai region. Hence we submit that the definition of "forest" must be understood in its widest sense, according to the Wildlife Protection Act, and by including these important ecosystems.

Reference: Dey, S., Sagar, V., Dey, S., Choudhary, S.K (2010). Sight record of the Indian Wolf *Canis lupus pallipes* in the river Gandak floodplains. Journal of the Bombay Natural History Society, 107, 51-53.

2. "However the wildlife clearance is applicable only for the stretch of Passing through the Valmiki Tiger reserve area. No forest diversion / tree cutting is required…"

Comment: We do not agree with this statement. See our detailed response to point 1 above.

Page 7, 1.2, Need of the Project: Paragraph 1.

Comment: All sectors (road, rail, waterways, air) are expanding in India today. A significant part of this expansion occurs often at the cost of natural wealth of the nation. Some of this is inevitable, but it is difficult to understand how each sector justifies its own expansion by stating that other sectors

are either congested or costly. With waterways, the argument is that road and rail networks are saturated and potential is stagnating – however, if we look at government vision documents (e.g. Railways Vision 2020, Government of India, 2009, 62 pp.) it is clear that all sectors are only expanding multi-fold through a rapid infrastructural boom. Hence, the claim that road and rail transport are stagnating does not seem to be an adequate justification to promote waterways development.

The last sentence is also incomplete.

Page 7, 1.2, Need of the Project: Paragraph 2.

Comment: It is true that IWT was an important mode of transport until the 20th century. However, the technology of running and managing waterways, and the amount of water available to ply boats / barges was substantially greater than today. One of the gross limitations of the EIA is that it does not consider the competing needs explicitly in determining the feasibility of the Gandak waterway. Irrigation from the Eastern and Western Gandak Irrigation Canals is a major demand on the water. Projected irrigation demands from the river are also expected to increase in the future. What, then, will be the status of flowing water available in the river? These are complex and important questions for the sustainability of waterways projects, but not discussed in any detail. The general perception is that when depth reduces, dredging will be done to carve out a way. This approach is short-sighted at best and projections of water demand, uncertainty due to climate and land use changes, etc. are critical to incorporate in environmental impact assessments also. With reduction in water availability, impacts of waterways on ecology that may not be visible today could become apparent later on.

Page 8: Figure 1.1: Location Map

Comment: This map is incomplete and misleading. More specifically, the boundary of VTR is not depicted accurately – the Valmikinagar and Madanpur ranges (along the Gandak River) are not shown. Sohagi Barwa Wildlife Sanctuary (Uttar Pradesh) is entirely omitted from this map, and elsewhere in the rest of the EIA document.

Page 9: Paragraph on 'Economic Advantage'.

Comment: All the references cited in this paragraph to support economic advantages are based on old references. There is no mention or even recognition of disadvantages or option values in waterways development when it comes to environmentally linked economic costs. In developed countries, the disadvantages of waterways have already become clear and efforts are ongoing to restore the ecological values of these waterways. In India, however, there is an inexplicably stiff inertia in accepting that there can be disadvantages, instead of incorporating concerns in assessments.

Page 9 -10: Economic Advantage: "Further the NW-37 can be developed as international waterways since the Gandak river also traverses in Nepal territory."

Comment: (1) Has Nepal indicated any interest in developing the portion of the Gandak flowing through its territory as an international waterway? (2) **Since the Gandak flows through a portion Nepal (Susta, Nawalparasi District) downstream of Triveni, how has the entire section from Triveni to the Gandak-Ganga confluence been declared a "National" Waterway**?

Page 10: Environmental Need: Potential for Fuel Efficiency and GHG Emission

Comment: Do these comparative estimates account for (1) up- or down- river movement, (2) flow velocity, (3) energy / fuel requirements of maintenance dredging?

Page 10: Environmental Need: Potential for Fuel Efficiency and GHG Emission: Last line: "The only disadvantage to IWT may be due to associated environmental impacts on aquatic life but the same is manageable with appropriate mitigation measures."

Comment: Are there any studies or examples to suggest how the environmental impacts of waterways on aquatic life can be managed, and if so, how will these be adapted specifically to the Gandak?

Page 11, sections 1.4 and 1.5.

Comment: It is not clear whether cumulative impacts and indirect impacts have been taken into account while preparing the EIA. Cumulative and consequential effects (i.e. cascading effects not directly estimable at the present juncture) need to be discussed in the EIA. Otherwise the assessment remains limited only to direct and immediate impacts at the short term.

Page 12: 500 m radius.

Comment: It is not clear this radius is with respect to what exactly. One would imagine a 500 m linear buffer along the line of vessel movement.

Page 13: Primary data collection (details in Table 1.3).

Comment: The primary data collection is focused around terminal sites. We understand the constraints of sampling. However, it would have helped if there was a clear indication of how the along-waterway sampling of different parameters was conducted, if any.
Page 14: Noise environment in Table 1.3, & Table 2.1 (general)

Comment: It is not clear whether underwater noise was monitored (Table 1.3).

In general, an important gap in the existing Noise Pollution (Regulation and Control) Act, 2000; and amendments, is that there is no recognition or understanding of underwater noise impacts. Even in the existing Water (Prevention & Control of Pollution) Act, 1974; noise is not included in the list of pollutants (ref. Table 2.1). Even international guidelines such as MARPOL do not explicitly include sound in the list of polluting substances.

Of course, the EIA agency cannot do anything about it in the current status quo of policy. But, as a matter for larger discussion, this is an area that deserves intervention at the level of the MoEF-CC, so that the Act could be amended to include this key aspect.

Page 18-33: Chapter 2. Administrative and Legal Framework

Comment: The Convention on the Conservation of Migratory Species of Wild Animals (CMS) has not been listed. India is a party to the CMS, and the gharial (*Gavialis gangeticus*) and South Asian/Ganges River Dolphin (*Platanista gangetica*), both found in the Gandak River, are listed in Appendix 1 of the CMS (which is incorrectly given as Appendix 2 in the EIA document).

Page 30: Table 2.2

Comment: It is not clear what the current status of river-level clearances is, in terms of river basin scale approval of inland waterways development projects by the Ministry of Environment, Forests, & Climate Change (MoEF-CC). In between, there was a debate on this issue between the MoEF-CC, IWAI, and Ministry of Shipping. This is an important area and applies to issues related to "Regulatory Clearances / Permissions" sections up to page 273 (e.g. section 9.5) and 274 (Conclusions).

Page 30: MARPOL Annexes.

Comment: Underwater noise pollution does not explicitly feature in the MARPOL annexes. However, it is useful that the report mentions the United Nations Convention on the Law of the Sea (UNCLOS) on page 31, in which noise pollution impacts have been acknowledged. The International Maritime Organization also includes noise as an important form of pollution in aquatic ecosystems.

Given the above gaps with regards to noise pollution, there is a need to develop national-level guidelines and preventive measures on underwater noise, which will be a positive change in policy.

Page 34: Section 3.2, General Introduction.

Comment: The name of the Gandak river in Nepal is 'Narayani' and also 'Gandaki' in some parts of the Nepal floodplains.

Pages 34-35: Projections of waterways transport.

Comment: Our observations on the Gandak River indicate that small-scale, across-river ferries for carrying people, livestock, vehicles, and agricultural loads, are a more immediate need of some local human communities than large-scale, mega-development transport longitudinally on the river. How existing transport systems could be developed and made more sustainable should therefore be a priority of socially relevant waterways development. However, the proposal of the Gandak waterways development appears to focus on industrial interests than simpler, local human needs. This is not a comment on the EIA per se, but on the project at large: our comment highlights the priorities of potential local dependence on waterways to be considered. This can also be an important downscaling option given that the environmental impacts of large-scale dredging etc. on aquatic wildlife are anticipated by the EIA itself.

Page 36-37: Table 3.2.

Comment: (1) The numbers in the table do not add up. For instance, commodity tonnage originating from Nepal is the same for 'Direction 2' and 'Both Direction'.
(2) The DPR mentioned here and elsewhere in the document has not been made available nor does it appear searchable on the websites of IWAI / RITES. The source of data used in the DPR, and details of how the Anticipated Traffic Projection / Estimated Annual Cargo Loads have been calculated are not known.

Page 38: 3.5 Challenges for project development.

Comment: All the highlighted challenges are critical to the proposed development and mitigation measures for the waterways on the Gandak River. It is a good sign that the EIA has recognized these. However, there is little detail provided on what the contribution of these challenges could be in terms of constraining the proposed scale of development. What we mean by this is that given the high rates of braiding, erosion, large water level fluctuations, etc., how much of the estimated potential of the IWT on the Gandak is likely to be limited or reduced. Currently, no analysis in the report actually looks at scenarios for sustainable waterways development given these very realistic challenges, which are 'natural limits' that need to be respected.

Pages 41-46: 3.7. Available flow in NW-37.

Comment: The report has access to data from the Central Water Commission from 1996 to 2008. However, there is no analysis of trends in river flow (discharge, water level etc.) or rainfall-runoff-recharge relationships presented. It would be important to look at how the trend of discharge changes, not only seasonally, but also year to year, so that water availability for IWT can be modelled in relation to irrigation, ecology, power generation etc. based on the use of water by the Eastern and Western Gandak canals. Canal irrigation in the Eastern Canal system of the Gandak has been inefficient in recent years because of maintenance works, which might be affecting river discharge positively. However, when irrigation demands increase, the reverse picture could emerge. Waterways needs, including dredging estimation and planning, depend strongly on water availability in the river channel at different times, which depends on canal withdrawals in turn. The EIA presents data only for the year 2006, which makes it impossible to address these critical questions that impinge directly on waterways development. *Thus, the lack of hydrological modelling to identify discharge trends and water availability changes is a major lacuna in the EIA report.* At present only raw data is provided in these pages for different sites, and no inferences except seasonal flooding changes can be made. In addition, water exchanges between the river and the surrounding groundwater aquifer are important, as groundwater abstraction is high in agricultural areas, and can impact river flow significantly. *These complexities are not addressed in the EIA.*

Page 47. Table 3.13

How were the shoal lengths calculated? If we calculate the ratios of shoal length to chainage lengths, it is 1 in all stretches. This means shoal length is equal to river thalweg distance. Does this mean that the whole river will have to be dredged, as indicated in section 3.9 on Maintenance Dredging***? If this is the case, one can only begin to imagine the total impacts of such a damaging intervention on a biodiversity-rich river like the Gandak.*** The whole section from 3.7 to 3.9 indicates that dredging should be done. This is an unfortunate stance to be taken for an EIA, which should ideally think of dredging only as a last option, instead of an inevitable need. Pre-emptive approaches are needed to identify the optimality of navigation in a shallow, sediment-rich river like the Gandak, instead of emphasizing intensive and damaging interventions like dredging.

Page 48: Section 3.9.3 Selection of Dredging Equipment

Comment: This whole section reads like this is not part of an EIA, but instead, a dredging contractor's proposal. Please refer to our earlier comments on how dredging impacts (which are actually acknowledged in the report itself) can be severe and why dredging should only be a "last resort" option rather than a project priority, as the EIA makes it sound. Given the erosion rates and sediment fluxes in the Gandak River, the effectiveness of dredging for channel maintenance from

year to year will only become apparent in the process of doing it. *We have already provided observations and reasons of why we have misgivings about the effectiveness of dredging in relation to its potentially disastrous impacts on the Gandak River.*

Pages 53 to 76: Terminal Design and Development.

Comment: There is no clear analysis presented here of channel course changes of the Gandak River from year to year due to meandering cutoffs, braiding and sediment plug formation, and abrupt tectonic shifts. This analysis would have been useful in justifying the selection of sites for the terminals. The Gandak River is not embanked or channelized in a major way for at least 100 km downstream of the Bhainsalotan (Valmikinagar) Barrage. This section has an active, dynamic, and productive river floodplain with frequent shifts in the flow of the active channel courses. Embankments proposed for the terminals are not major, but still are likely to cause some changes in flow characteristics (mainly from Bagaha to Kalyanpur). These consequences appear to have not been explicitly accounted for in the siting and design of the terminals. As mentioned earlier, the Gandak has very high bank erosion rates due to hydro-geomorphological peculiarities and a steeper flow gradient than other comparable Himalayan rivers. Channel course changes would be expected and can be challenging for terminal management, as already mentioned in the report itself (Page 38).

Page 77: Chapter 4, Section 4.1 (General): However the northern fringe of the NW-37 (Gandak river) is abuts the Valmiki National park & Wildlife Sanctuary.

Comment: Please refer to our comments above on this matter.

Page 78: 4.2.2: Environmental Setting and Salient Environmental Features of the Project Area: "However, the nearest Bagaha terminal site fron the Valmiki Tiger Reserves located more than than 19 km from the Valmiki Tiger Reserve (VTR) boundary (refer Figure 1.1)."

Comment: This is incorrect and incomplete. The distance between the proposed Bagaha terminal and the nearest part of VTR (Madanpur Range) is less than 3 (three) km.

Page 78, Table 4.1

Comment: Row A has no mention of Sohagi Barwa Wildlife Sanctuary, Uttar Pradesh which has excellent aquatic and riparian habitat for endangered species such as Gharial, Mugger and dolphin besides being part of a well-known tiger corridor (Chanchani et al. 2014, WWF-India 2013). Row B: some grasslands within Madanpur range of VTR are also part of protected/reserved forest along the river, being a key part of the National Park and Sanctuary. However, these grasslands have not been mentioned here. Row C: being only the fifth wild breeding population of the critically endangered Gharial crocodile in the world, the Gandak River itself is an aquatic ecosystem of not only national but international importance. However, this important attribute has not been recognized here. For more information on 'Wetland of state and national interest', please refer to the National Wetland Atlas produced by Space Applications Centre (ISRO), Ahmedabad, and Institute of Environmental Studies & Wetland Management". Row D: the whole Gandak Terai grassland serves as a migratory corridor for young dispersing tigers and other wildlife, especially during the monsoon season. Tigers are known to move along the river with the floodplain grass growth in the peak floods. In 2012, a tiger was reported almost 200 km downstream of VTR (Bihar Forest Department, personal communication). So the migratory routes are not restricted to the VTR as the Table suggests. Row E: Presence of Schedule-1 terrestrial fauna also includes the regular or occasional presence along the river floodplain of schedule-1 species like the smooth-coated otter, fishing cat, rhinoceros, etc.,

which are not mentioned. Only tiger and leopard are mentioned. VTR also has one of the important remnant populations of Gaur in the Terai. Row F: Both Mugger and Gharial are found in the Gandak River in good numbers (according to the Wildlife Trust of India and Bihar Forest Department). However here it is mentioned as Gharial/Mugger, which means the EIA report is not clear about the presence of these species. Row G: Many birds are found along the river also, which are rare. So birds should be included as 'yes' in the 500 m core zone of the NW-37. VTR and Sohagi Barwa Wildlife Sanctuary are both designated as *Important Bird Areas* by Bombay Natural History Society (BNHS) and BirdLife International.

References:

Chanchani P., Lamichhane B. R., Malla S., Maurya K., Bista A., Warrier R., Nair S., Almeida M., Ravi R., Sharma R., Dhakal M., Yadav S. P., Thapa M., Jnawali S. R., Pradhan N. M. B., Subedi N., Thapa G. J., Yadav H., Jhala Y. V., Qureshi Q., Vattakaven J. and Borah J. 2014. Tigers of the Transboundary Terai Arc Landscape: Status, distribution and movement in the Terai of India and Nepal. National Tiger Conservation Authority, Government of India, and Department of National Park and Wildlife Conservation, Government of Nepal, 98 p.

Maurya, K. K. and Borah, J. (WWF-India) 2013. *Status of tigers in Valmiki Tiger Reserve,Terai Arc Landscape, Bihar, India*. WWF-India.

Rahmani, A., and Ul-Islam, Z. (2004). Important bird areas in India: priority sites for conservation. IBCN, Bombay Natural History Society & BirdLife International, Mumbai, India. 1133 p.

Rahmani, A.R., Bhargava, R. and De, R. (2015) Avifaunal Studies at Sohagi Barwa WildlifeSanctuary: Final Report. Bombay Natural History Society, Mumbai. Pp. 77.

Pages 79-80: Table 4.2.

Comment: The distance between the proposed Bagaha terminal and the nearest part of Valmiki Tiger Reserve (Madanpur Range) is less than 3 (three) km. There are many wetland and grassland areas along the Gandak River, which are not under formal protection (National Park, Wildlife Sanctuary, etc.), but still harbour rich biodiversity. Areas such as Singhahi Dhala near Kalyanpur terminal offers an excellent grassland from where Indian Wolf, Hog Deer, Floricans, and roosts of migratory harriers have been recorded by our team. There is no mention of such sites in the report, which we feel is important to include in comprehensive impact assessments.

Row 11: please refer to our earlier comment on 'gharial/mugger'. These are two distinct species and both are found in the Gandak river.

Page 85: 4.3.2 Drainage Pattern.

Comment: Here it says the total length of the river in India is 335 km. This is inconsistent with the length provided elsewhere in this same report, at 295.6 and 320 km.

Pages 94-95: Classification of agricultural land.

Comment: Agricultural land classification is the most dominant category, and as a result might also include grasslands / fallow lands / temporary alluvial scrub etc. It would have been better if area under specific cropping across seasons was conducted.

Page 109: Groundwater use in conjunction with canal irrigation.

Comment: We agree that groundwater resources are being heavily tapped along with canal irrigation in the Gandak basin. However, it would have been useful to actually look at how the tapping of groundwater might also affect water availability in the river for waterways – especially in the dry season, as the river and shallow groundwater aquifer are connected and have regular exchange and recharge of water.

Pages 110-125: Data on water and air quality

Comment: We appreciate the efforts taken by the EIA team in generating the primary data and providing useful time series. A trend analysis to detect change in these characteristics would have additionally helped. However, the data provides a useful baseline for monitoring impacts of waterways developments in the future.

Page 127: 4.7.2. Forest Type

Comment: We have never seen oak in any part of the Gandak valley. Oak species are reported to occur in the sub-Himalayan forests of VTR as per the report, but this seems erroneous.
Additionally, within the Tarai (Terai) 'forest' types, we would have liked to see mention of extensive Bhabbar grasslands and scrub forests, which are also a crucial habitat for terrestrial wildlife.
Page 128: 4.7.4. Critical sensitive ecosystems within NW-37 stretch

Comment: Sohagi Barwa WLS (Uttar Pradesh) is omitted from the list for unexplained reasons.

Pages 135, 140, 144, 148, 152: Throughout this section the Ganges River Dolphin has been assigned the Latin name *Gavialis gangeticus*, which is the name for the Gharial crocodile. We suspect that this is not just a typological lapse. From the way this mistake has been repeated at several instances, it appears that those in charge of this section have no idea of the difference between the dolphin and the crocodile. That appears like a serious lacuna. Not only that, it has implications for other places in the EIA report where the dolphin's name and details have been mentioned correctly, as it creates confusion about what references / information sources have been followed. It is no secret that many local people in the Gangetic plains refer to the dolphin as the "Soons-Gharial", because of the superficial similarity in their snout (rostrum) and teeth. The EIA needs to correct this serious mistake and check throughout whether the correct information is provided consistently.

Page 135: Higher aquatic vertebrates

Comment: There are likely at least 13 species of turtles found in the Gandak River, several of which are listed in Schedule-1 of the Wildlife Protection Act (1972), and/or as Critically Endangered / Endangered in the IUCN Red List. The EIA reports no information on the turtle diversity and it appears that this information is not known to them.

Page 135: Paragraph on Dolphin.

Comment: Clearly, the EIA report, in this instance, does not seem to understand the difference between Dolphins and Gharials. First, it gives the gharial's Latin name to the dolphin. Further, it provides unclear information on the dolphin, and for some reason only restricts information to the VTR. Over 265 dolphins have been recorded throughout the whole NW-37 (Gandak River) as per Choudhary et al. (2012) from 10 km downstream of Triveni all the way up to the Gandak-Ganga Confluence. This vital information has been clearly overlooked by the EIA.

Reference: Choudhary SK, Dey S, Dey S, Sagar V, Nair T, Kelkar N (2012) River dolphin distribution in regulated river systems: implications for dry-season flow regimes in the Gangetic basin. *Aquatic Conservation: Marine and Freshwater Ecosystems* 22: 11–25.

Page 135: Paragraph on Mugger.

Comment: Correct Latin name for the mugger or marsh crocodile is *Crocodylus palustris*.
Is there data to support that 'Incidents of Mugger interaction and resulting conflict keep happening'.

Page 135: Paragraph on Gharial.

Comment: This does not mention that the Gandak River is one of only five breeding sites for gharials (Critically Endangered) in the entire world. This makes it an area of high conservation priority and accords it a very special status emphasizing the need for exempting the area from large-scale development interventions that can have adverse ecological effects. Researchers of the Wildlife Trust of India have not only monitored the tagged gharials, but also recorded over 50 individuals, including adult females and males, and also recorded breeding sites of this rare crocodile in the Gandak river floodplain. This important detail has been completely missed. This is also the world's only trans-boundary population of gharials, with gharials from Nepal's Chitwan National Park (Narayani-Rapti Rivers) known to move and reside in the Gandak River. In addition, at least 30 gharials have been released by the Bihar Forest Department in the Indian side of the Gandak River during 2014 and 2015.

As evidence in support of our comments, we are providing maps of A) river dolphin distribution (red dots), and B) gharial distribution (white dots) in the Gandak River in relation to the four terminal locations, in the image below. The blue line is the river and the pale blue background is the river's active floodplain area.

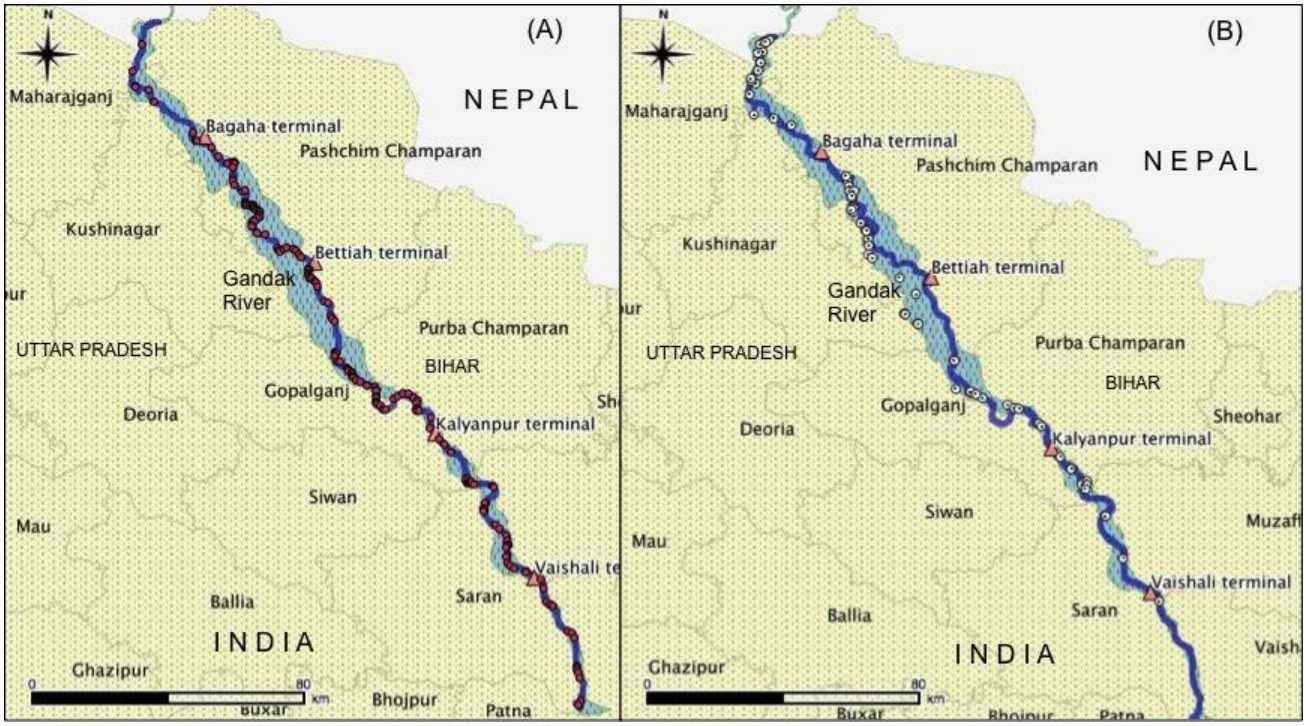

Table showing distances of identified habitat of critically endangered gharial and endangered Ganges river dolphins from the four proposed terminals on the Gandak waterway NW-37.

Terminal	**Distance to nearest gharial habitat (km)**	**Distance to nearest dolphin habitat (km)**
Vaishali	3.44	1.68
Kalyanpur	1.95	1.71
Bettiah	4.42	1.80
Bagaha	1.99	1.03

References:

1. Choudhury BC, Behera SK, Sinha SK & Chandrashekar S. (2016) Restocking, monitoring, population status, new breeding record and conservation actions for gharial in the Gandak River, Bihar, India. Pp 124 in Crocodiles. Proceedings of the 24th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
2. Nair, T. & Katdare, S. (2014) Summary report on gharial surveys in the Gandak River. Submission to the Bihar Forest Department, April 2014. 7 pp.
3. Choudhary, S.K. et al. (2012) Aquatic Conservation, 22, 11-25.
4. Dey, S., Sagar, V., Dey, S., Choudhary, S.K (2010). Sight record of the Indian Wolf *Canis lupus pallipes* in the river Gandak floodplains. Journal of the Bombay Natural History Society, 107, 51-53.

Pages 135-152: All paragraphs on 'Fisheries'.

Comment: According to CIFRI (Central Inland Fisheries Research Institute), Barrackpore, the Gandak River has a high diversity of colourful fishes that are exploited for the aquarium trade. Many fishers in the river are regularly involved in this activity. It is also important to note that loaches, some barbs, gouramis etc. fished from the river for aquarium trade are mostly benthic (bottom-substrate dwelling) species and occur in the colder water stretches from Valmikinagar to almost Chatia Diyar. Dredging is likely to significantly affect this diversity and the livelihoods dependent on it – however the EIA does not even once mention this aspect.

Reference: Sinha, A., Jamal, A., (eds.) 2015. Freshwater ornamental fish of Bihar. CIFRI, Barrackpore Bulletin No. 191.

Pages 136-151: All Tables listing 'Fauna' or 'Wildlife' in the study area.

Comment: All mammal lists provided in these tables are incomplete. We have already mentioned that the Indian Wolf occurs in areas right up to 200 km downstream of the Triveni barrage. Many other rare mammals (e.g. pangolin, smooth-coated otter, and species of rodents and bats) are known from the basin (WTI & ZSI reports) but not mentioned here. Some English names are generic and exact species are not reported (e.g. Mongoose, Monkey etc.). These cannot be considered 'minor

errors' because this reflects poorly on the overall quality of the wildlife- and biodiversity-related sections of the EIA.

Page 137-150: These pages repeatedly mention the following: "No significant wildlife is observed in the study area as there are no national parks, bird's sanctuaries, wildlife sanctuaries, Elephant / Tiger Reserve (existing or proposed), migratory routes/ wildlife corridor or reserved forests within 10 km area of the terminal site. The terrestrial fauna includes common invertebrates and vertebrates. No other schedule-I species of Wildlife (Protection) Act.1972 is present in the study area. The list of faunal species is given in Table 4.29."

Comment: We feel that this statement is unscrupulous and indicates problematic understanding of some concepts. It assumes that "significant wildlife" is found only in protected areas and nowhere else, which is a fallacy and shows sheer ignorance. The National Wildlife Action Plan (2017) of the MoEF-CC explicitly recognizes that many wild species, including endangered species (if that is what is understood by the EIA as 'significant') are also found well beyond national parks and sanctuaries. Further, is the river itself not an environmentally sensitive ecosystem, a migratory route, and a wildlife corridor for many animals? We have pointed out this fact repeatedly in earlier comments: the river is a crucial migratory route for migrant waterfowl (who stopover on the river), for fishes (migrating upstream and downstream), and for endangered species like gharials and river dolphins. Not only that, the river floodplain is a regular dispersal corridor for tigers, which is acknowledged by the Bihar State Forest Department. Moreover, the river itself is a crucial ecosystem likely to be damaged by many interventions of the project, whether it is under some 'legally notified' sanctuary or not. We have already highlighted the irreplaceability value of the Gandak River as a breeding site for the Critically Endangered Gharial. Gharials and dolphins are both under Schedule-1 of the Wildlife (Protection) Act, 1972. So the statement that no schedule-1 species are found in the study area is incorrect. We urge the Bihar Forest Department to be sensitive to the way this information is provided in the EIA.

Page 143: The nocturnal birds found in the area are Bat (Pteropus giganteus) Owl (Bobo bobo), Bee-Eaters, Shrikes and Wegtails. All the birds are found near fresh waters and wet irrigated fields feeding actively on insects.

Comment: This is another good example of the poor quality of biodiversity assessments throughout the EIA. 1) Bat is called a Bird. That is a serious mistake. Bats are flying mammals, and NOT birds. 2) Bee-eaters, shrikes, and wagtails are not nocturnal birds. 3) All birds are found near freshwaters and wet irrigated fields, feeding on insects – this sentence does not make any sense.

The report itself mentions earlier that 241 species of birds are found in the Gandak River, which includes raptors (flesh-eating, carnivorous birds), storks and waders (fish-eaters), and ducks (algae and plant feeders). Hence the claim that all birds eat insects is ridiculous. Further, the report misses out on mentioning vultures (critically endangered species like White-rumped Vulture are found along the Gandak River) in the first sentence of this paragraph.

Page 161: 4.8.5. "Major fish species of Gandak River adjoining are Dolphin (Platanista gangetica) Hilsa, major carps, minor carps and large catfishes Cultured Carps, Channa, Puntius, Anabas, invasive alien fishes such as Tilapia, Pangasiodon, African Catfish, Rita, Catla, Mystus, Labeo species etc., and all are having the commercial importance within the Vaishali region."

Comment: This sentence is rather shocking and once again highlights the poor quality of work on the biodiversity component of the EIA. The Dolphin is NOT a fish species but a mammal. Not only that,

it is India's National Aquatic Animal. If the EIA agency does not even understand this basic difference, then it is indeed a sad state of affairs. The Ganges River dolphin (Platanista gangetica) is an Endangered river dolphin according to the International Union for Conservation of Nature (IUCN) and is also a Schedule-1 species as per India's Wildlife Protection Act (1972). The National Waterways Act that is being implemented in nearly all the rivers of the Gangetic basin poses a major threat to this unique mammal species. It is not a fish nor has commercial importance in the context of fisheries. So this statement is plain wrong and deserves serious attention by the Bihar state government authorities who will be reviewing the EIA report.

Secondly, but importantly, how can "Cultured Carps" be a major fish species of the Gandak River? Cultured Carps is a category for 3-5 species of carps (both native and exotic) that are used in pond fish culture. Similarly, Tilapia and African catfish are exotic species not found in the river, but in ponds and wetlands around. Tilapia are found in wetlands of the Gandak basin, but there is possibly no introduction of African catfish in the basin, except perhaps in a few artificially managed culture ponds. Pangasiodon is also under culture, but luckily, is not an invasive alien species of fish. Rita, Catla, Mystus, Labeo, etc. on the other hand, are NOT invasive alien species, but native riverine species. Rita, Mystus, and some small species of Labeo are not even under culture.

All these facts indicate that this section of the EIA report is wrong and poorly prepared. It also reveals incompetence of the EIA agency in matters of biodiversity in general and aquatic vertebrates in particular. First they confused the dolphin with the gharial (a reptile), and now they are calling it a fish!

Pages 164-166: Table 5.1. Impact Matrix for NW-37.

Comment: The entire matrix has NO mention of underwater noise impacts. All mentions of noise pollution impacts are limited to ambient noise in air. Underwater noise impacts, both due to dredging and vessel movement, are likely to be serious on aquatic fauna including river dolphins, fishes, gharials etc. The omission of this serious concern of the project is a major lacuna in the EIA. We have explicitly described elsewhere in our comments on how underwater noise can hurt many sensitive species, especially river dolphins, which depend almost entirely on high-frequency clicks for navigation, feeding, communication, etc. Although boat engine and dredging noises are low-frequency dolphins are likely to still hear them and indicate stress-responses. More importantly, cavitation noise (noise of bubbles produced by propellers) is very high- frequency and actually overlaps with the echolocation clicks of river dolphins. We have discussed this issue in detail later on, as comments on the relevant sections of the EIA.

Page 169: "Ganga river carry high sediment load and its aquatic life is accustomed to high sediment level of river."

Comment: Aquatic life may be accustomed to sediment load in rivers in the natural state. However, what is meant by "high" load is meaningful only in strictly relative terms. It would be wrong to assume that because rivers of the Gangetic basin are already turbid in nature, dredging-induced acute and chronic effects of turbidity will have the same effects. In fact, rapid surges in turbidity and sediment load pulsing through the river during dredging could have serious impacts, dependent on the duration/intensity/timing of dredging activities. It is important to distinguish such pulses and their acute and chronic effects from baseline 'high' sediment load. Only then the effects of dredging-induced sediment flux alterations can be correctly estimated. Acute effects of dredging and their immediate consequences might of course be easier to estimate than gradual, latent, and chronic impacts.

Page 169: “The most of fishes‘ activities are found in 15-30 cm depth of the river.”

Comment: This statement is not only baseless, but it is also incorrect. Depending on river depth, fish are known to occur throughout the water column from surface to bottom. Even in very deep channels, some fish species occur to extents of 20-25 m.

Page 169: Mitigation measures – point no. 1

Comment: We agree with this point in that there is a need to minimize and optimize dredging requirements. Our only suggestion is that, although it is useful to look at effectiveness of bandalling practices and vessel design in the short-term, it will be vital to understand how water availability in the river channel itself varies as a result of irrigation demand, power generation, and other diversions of water through the Triveni barrage-canals and local abstraction of surface water.

Page 169: Mitigation measures – point no. 3

Comment: It is good to note that the EIA has given a sound recommendation of ‘not dredging’ during the very low flow season. However, how has the ‘very low flow’ been defined? Indeed, it is difficult to define this as it varies from year to year – and hence, some form of adaptive management and estimation of dredging needs is crucial. Furthermore, dredging needs are the highest during the lowest river flow periods. How can this positive recommendation address this issue? We would suggest that at the time of implementation, a constant monitoring exercise must be in place to determine adaptive, dynamic decision-making on dredging requirements.

Page 170: 5.4.2.1. Dolphins, Mugar, Ghariyal are the invertebrates reported in the river system.

Comment: Once again, the section on impacts on aquatic biodiversity is let down by such wrong statements. Dolphins, muggers, gharials are all vertebrates, NOT invertebrates. This is such a basic mistake that we find it hard to believe that it is just a typological error. There is so much inconsistency throughout the EIA – the dolphin and gharial information has been mixed up first, then the dolphin has been called a fish, and then all these animals have been called ‘invertebrates’ now. In some places correct information is provided, but it is generally from other sources (e.g. Bihar Forest Department), which are not part of the EIA. Wherever the information is compiled by the EIA agency, we find it to be highly inconsistent and highlights major limitations on the biodiversity and ecology aspects.

Page 170: 5.4.2.1. Noise generation during dredging operations is of order of 160-180 d(B) for CSD category of dredgers. Behavioural disturbance criteria for Dolphins, Mugar, Turtle from any continuous noise exposures are 177 d(B) and 150 d(B) respectively (As per Environmental Impact Statement of South of Embley Project). In addition, no dredging operations are proposed within or in vicinity of Valmiki Tiger Reserve & Sanctuary area that minimise the possibility of the impact of dredging on such vital sensitive organisms.

Comment: We refuse to accept the criteria for behavioural disturbance that have been borrowed from the South of Embley project EIA statement. There is absolutely nothing in common in the ecological issues related to this Australian (Queensland Government) project and the Gandak River. The Embley project is a bauxite mining project supported by Rio Tinto, whereas the waterways has nothing to do with mining, except for sediment dredging. We expect that the EIA agency at least knows that all dolphins, all turtles, or all crocodiles are NOT the same. The criteria for dolphins and

turtles developed in Queensland thus cannot be used for Ganges river dolphins, gharial crocodiles, or the 10+ species of turtles that occur in the Gandak River. These species evolved in the Indus-Ganga-Brahmaputra basins and are rather unique in their ecology and functional morphology from many other species. The moot point here is that without knowledge of hearing sensitivities and sound source levels emitted by the Ganges river dolphin, gharial, or other species in the Gandak River, one cannot directly correlate the dredging noise in the 160-180 dB range with 'disturbance criteria' for these species in particular. For the information of the authorities concerned, we have computed the sound source level of Ganges river dolphins in the Ganga River, which is estimated at 166-186 dB re 1 μPa pp at 1m as well. In simple words, what this means is that the loudness of the sound of the river dolphin, for given peak frequency of around 70 kHz, is the same as the loudness of noise emitted by the dredging activity. Jensen et al. (2013) report from their work in Bangladesh on the same dolphin species, that sound source levels are higher (180+). This difference is probably due to natural background noise from tidal action. The simple logical conclusion of this overlap is that dolphins might not be able to hear their own echoes if the surroundings also have loud sound, such as that created by dredging. There is one knowledge gap here: how acute is the hearing sensitivity of dolphins to this? For this, the closest bit of information comes from Zbinden et al. (1978) who conducted captive studies on Indus dolphins (a subspecies of Platanista gangetica). Zbinden and team found that Indus dolphins had acute sensitivity not only to an area of around 70 kHz (matching their own signals), but also to lower frequencies at about 10 kHz. From this, as well as from Southall et al. (2007) that has been cited in the EIA, we might be able to confirm that Ganges dolphins hear all frequencies from 1 to 100 kHz, at different sensitivities. This is a crucial finding and until and noise modelling must be properly undertaken for a mechanistic understanding of sound impacts on dolphins. At present, there is no inference drawn from the criteria reported in relation to dredging noise intensity (loudness).

While we agree with some parts of the paragraph that there will be impacts on behaviour, habitat loss, and disturbance, we do not find any clear inference based on the matching of the disturbance criteria. The absence of clear inference thus delinks the mitigation measures from adequate knowledge of the underwater noise problem.

One significant limitation is that dredging or vessel noise is not broken down into its various components: engine source noise, cavitation noise from bubbles emanating during dredging period, etc. As indicated earlier, cavitation noise is an important disturbance because it is similar in frequency to river dolphin frequencies. However, there is no explicit mention of the same in underwater noise impacts.

Further, regarding the details provided for fish sensitivity levels to sound: these criteria / thresholds are for which fish species? Do we have any studies that look at sound exposure sensitivity for even a few species actually found in Gangetic basin rivers? As these studies are not cited here, we would caution against using disturbance criteria for fishes from foreign sources (USFWS) without checking for the comparability of their study conditions and the study area on which the EIA is made.

It is also problematic to assume that "since the dredging activity is short term, the aquatic fauna will move back after the disturbance is removed". As we have hinted earlier, this would depend on the type of organisms, as well as the manner, timing, intensity, frequency, and duration of the dredging involved. In the absence of detailed studies, such foregone conclusions are risky and counterproductive for organisms with high environmental sensitivity to dredging effects. This point is in a way acknowledged in the next paragraph of this very EIA report itself.

References:

1. Jensen FH, Rocco A, Mansur, RM, Smith BD, Janik VM, Madsen PT (2013) Clicking in shallow rivers: short-range echolocation of Irrawaddy and Ganges river dolphins in a shallow, acoustically complex habitat. *PloS ONE* 8: e59284.

2. Zbinden K, Kraus C, Pilleri G (1978) Auditory responses of *Platanista indi*. *Investigations on Cetacea* 9: 39-64.

Page 171: Impact due to increased sediment load: "There is only need to be concern if sensitive species are near the maintained channel. Since river width is wide enough compare to 64m wide navigational channel, it is anticipated that aquatic life will get accustomed fast to regular activity phenomenon of the river and adjust their behaviour accordingly."

Comment: In the absence of any studies from our rivers on the sensitivity of species to such impacts, we find this anticipation / assumption rather risky. Having river width wide enough in comparison to the navigation channel is not enough. Typically, many organisms depend on both shallow and deep habitats in a river channel. For example, dolphins often use shallow areas for feeding, and deep areas for resting. Gharials use shallow areas for basking and guarding nests, but deep areas help them in escape from threats and take rest. Fish juveniles use shallow areas while adults use deeper waters. These things have evolved over millions of years. Dredging is a very new thing in these ecosystems and the high plasticity (physiological or behavioural) that is repeatedly assumed for river animals, may not be so. What is important, therefore, is to understand the whole river channel as an integrated habitat, rather than break it up artificially into dredged and undredged / navigated and free etc. In fact, because dredging happens typically along the interface between shallow and deep zones in the river channel, it is crucial to understand fine-scale impacts for diverse organisms first.

Page 171: No dredging should be undertaken within Valmiki Tiger Reserve & sanctuary.

Comment: Once again, this is based on the assumption that wildlife occurs only inside the sanctuary and tiger reserve. The species likely to be affected MOST by the dredging (dolphins, gharials, turtles, and fishes) occur throughout the Gandak river, irrespective of whether there are protected areas.

Page 172-175.

Comment: We have already provided specific comments on these sections in the summary on mitigation measures provided in the report at the beginning.

Page 175: "Polluters pay".

Comment: Who will monitor the impacts when the project gets implemented, in whichever manner? Monitoring is important and sanctions/penalties are also crucial, but if we get a sense of agencies responsible for holistic monitoring, it will help. Is the IWAI itself going to monitor these impacts? If yes, then there is a conflict of interest as the IWAI is also the project proponent and regulator. If not, then who will be the monitoring agency? Will the MoEF-CC or state environment department be involved? This should be clarified. In the EMP provided later, the involvement of environmental agencies in project impact monitoring and regulation is quite minimal, and this is a serious concern for endangered biodiversity.

Page 176: To minimize the chances of collision, restricted vessel speed of 2.7 knots (5 kmph) is proposed within Valmiki Tiger Reserve & sanctuary area. Even in low speed danger still exists for juveniles of dolphins and other fishes…

Comment: Restricting speed of vessels in VTR area only, does not make sense. As indicated several times earlier, river dolphins, gharials, fishes are distributed across the river stretch and assuming that speed effects on species will be restricted to VTR is wrong. Speed limits need to strictly apply for the entire stretch of the NW-37 if impacts actually have to be reduced.

Having said that, there needs to be focused study on how boat speeds actually affect species not only by direct collision impacts, but by engine sounds, propeller-induced cavitation noise, etc. No such studies are available at present to plan for mitigation measures.

Again here, the second sentence seems to indicate that the dolphin is a fish species. As indicated earlier, this is wrong, the dolphin is a mammal.

Page 176: 5.5.2.3 Eggs and larvae of fishes, crustaceans and molluscs, which are highly sensitive to even low concentrations of Ph.C. (10-100 µg/l) and aromatics (1 - 5 µg/l) will be severely affected. However, it is unlikely that any localised losses of fish eggs and larvae caused by a spill will have discernible effect on the size or health of future adult populations.

Comment: There is absolutely no basis for the second statement, given that severe impacts are anticipated. In fact, this assertion that localized losses of fish eggs and larvae will not matter for adult fish populations is baseless, unfounded, and dangerous.

Page 176: Most long distance (low frequency) noise is generated by the hissing‘ cavitation of spinning propellers.

Comment: It is well known that cavitation bubbles also generate high-frequency sounds due to breaking up, and sound reflection/scattering effects. Further, cavitation noise is more intensive but less persistent and low-frequency boat engine noise is less intensive but persists longer, especially in shallow water.

Pages 177-181: Impacts on Behavioural Response of Aquatic Organisms and on Auditory System of Dolphins Due to Noise Generation from Moving Barges

Comments: We have provided detailed comments on this section below. We appreciate the effort taken by the EIA agency to attempt to understand noise impacts through a meta-analytical approach, and to conduct underwater noise modelling (although they call it underground noise). Despite the effort, it is imperative to point out the following limitations.

1. We have already commented in detail on how the studies conducted by the South of Embley project cannot be assumed applicable for the Gandak River or for the Gangetic plains. We do not agree that the same criteria for behavioural disturbance thresholds can be used for all dolphins and turtles – as if they were all one species. So the 150 and 177 dB thresholds cannot be blindly followed here also. Further, shallow-water acoustics is far more complex and includes a range of sound reflection, reverberation, and other effects, so the above criteria cannot be directly used. Please refer to our comments on this issue made earlier.
2. Southall et al. (2007) report that river dolphins usually hear frequencies in the range 1-105 kHz. This estimate, however, finds no mention in the EIA report. At the very least (in the absence of accurate audiograms for Ganges river dolphins), we can take from this that river dolphins can hear a wide range of frequencies (although perhaps with different sensitivities). This important input has not been mentioned here.

3. Kelkar (2008) was an observational study and categorized noise levels purely based on number of boats in the area. It is a limitation of the way that study was conducted. In the context of the EIA, although it is slightly irrelevant as a reference, we agree that it does not conclusively show that noise does not affect behaviour.
4. The studies by Renilson et al. (2013) and Vessel noise impacts (2009) may be useful for vessel noise in relation to speed, but these studies have all been conducted in marine environments, not rivers. Thus, shallow water sound propagation issues are not directly addressed by these studies. Assuming high absorption of sound in shallow water (as done in page 179, as part of the "underground" noise study) may not be completely right, because a number of reverberation effects exist in shallow areas, especially for low-frequency sounds. In fact, Jensen et al. (2013) who have conducted an in-depth study of Ganges river dolphin acoustics have identified explicitly that the sound characteristics of the dolphin are a unique adaptation to shallow water environments with high clutter and reverberation effects. Surprisingly, a detailed, topical study on the same species of dolphin (Platanista gangetica) has not at all been cited in the EIA. Instead, irrelevant studies on marine dolphins (which are very different from river dolphins) have been cited and information from them has been borrowed without acknowledging the necessary caveats and assumptions.
5. If we indeed believe that the underwater noise modelling results yield an upper limit of 165 dB of underwater noise, it would be risky to directly conclude that these are tolerable by river dolphins. Earlier, we have provided a detailed explanation, with our own data, on how this sound level alone is not enough to conclude that there will be minimal impacts on river dolphins. We need information on dolphin sound source levels, target distance of echoes, background ambient noise in the river, and hearing sensitivity to accurately estimate impacts of vessel noise. As there are knowledge gaps in many of these data, we urge that until detailed studies are conducted on Platanista gangetica specifically, the results of the noise modelling exercise should be treated with deserved suspicion. The same goes for turtles: freshwater turtles are entirely different from marine turtles for which the 150 dB threshold is reported by a study from Australia. We have strong reservations about the claims made from the modelling study at present, given that biologically, we are talking about entirely different species and ecological conditions as if they were the same.
6. Page 180: Even if we assume that the conclusion is correct, that impact on auditory system of dolphins is not anticipated due to barge movement, there are certain gaps that must be addressed. Firstly, vessel movement engine noise is not the only source of noise underwater. Propeller action-induced cavitation noise is a major disturbance, and cavitation bubbles' sound frequencies are much higher than engine sounds, and can even overlap with the broadband clicks of Ganges river dolphins. Cavitation noise effects are not addressed in the modelling exercise. This leaves a significant limitation that needs to be addressed (as the same EIA report acknowledges later).
7. Page 181: Ganges river dolphins are not known to produce low-frequency whistles. However, they indeed produce low frequency burst-pulses (highly repetitive clicks). So we agree that communication clicks might be potentially masked by underwater anthropogenic noise. However, it may be noted that the dominant frequency of these dolphins (at 65-70 kHz), although higher than boat engine and pump noise, might overlap with cavitation noise frequencies. Again, without data on hearing sensitivity, it is incorrect to fully conclude that "noise generation due to barge movement is not anticipated to interfere with echolocation ability of Ganges Dolphins". Zbinden et al.'s study (cited above) shows that a peak hearing sensitivity occurs also in the low-frequency zone at around 10 kHz, apart from the dominant sensitivity being at around 70 kHz for Indus dolphins. However, there are likely to be certain sampling artefacts and methodological issues with this study. So, in the absence of hearing

data, which is exactly complementary to echolocation frequency data, we cannot assume the entire absence of any impact of low-frequency sounds either.

8. Mitigation measures, point 2: What are dolphin reflectors?
9. Mitigation measures, point 6: This, instead of reading like a mitigation measure, appears like a 'scaring' measure for dolphins by driving animals away by creating noise signals. Where might the disturbed animals go if this is actually done? We suspect there may be occasions where scared animals might get disoriented or entangled in fishing nets, leading to indirect mortality. We urge that such risk-prone measures be omitted from mitigation plans.

Page 183: Echo-sounding for LAD estimation.

Comment: Regular hydrographic surveys based on high-frequency echo-soundings are understandably important for safety of navigation. However, these echo-soundings might also have deterring impacts on river dolphins, more so because some components of high-frequency SONAR may be actually audible to dolphins at high sensitivity thresholds. Ensuring that the SONAR frequencies used are extremely high (over 300 kHz) and used carefully and sparingly to avoid background white noise in river channels, need to be part of mitigation measures to be undertaken during surveys also.

Page 200: 5.7.8.2 Impacts During Design and Construction Phase: Aquatic Ecology
No eco-sensitive aquatic habitats are identified within NW-37. However, Gandak River in northern fringe of the NW-37 forms the western boundary of the Valmiki Tiger Reserve is home to Ghariyal, Crocodile and Dolphins.

Comment: As we have repeatedly pointed out, the assumptions that eco-sensitive habitats are only within the Valmiki Tiger Reserve, and that gharials, crocodiles, and dolphins live only in the Reserve, are wrong. The entire river has gharials and dolphins, and thus the entire river stretch of NW-37 is an eco-sensitive zone that must be subject to detailed assessment and mitigation.

Page 200: Impacts of piling activity.

Comment: It is not necessary that all river organisms will avoid new structures being constructed in the river. Some fish species might actually select such structures for shelter or nesting, but might get deterred by noise. River dolphins might be curious about any changes in their habitat configuration (as dolphins are known to be) and might want to explore new structures closely, wherein they might be affected to variable extents by impacts of underwater noise from piling, in particular.

The same comment applies to the assumption made on page 203, in section 5.7.8.4. 'Impacts of operation phase on aquatic ecology'.

Page 204: 'Nesting grounds, breeding & spawning grounds shall be identified and project activities shall be minimized in those areas'

Comment: For river dolphins, it is not possible to assume specific breeding grounds. The river dolphin is a mammal and will respond adaptively to the dynamic nature of the river. Calves are birthed by dolphins in many different habitats, which are neither spatially restricted nor identifiable.

Page 205: Ship speed should be controlled especially in dolphin habituated stretch (Valmiki Tiger Reserve area) to minimize dolphin kill.

Comment: We reiterate that there is no such thing as a dolphin habituated stretch. 250-270 dolphins are found in the entire Gandak River (332 km) according to Choudhary et al. (2012). See reference above. Ship speeds thus need to be controlled throughout the river, not just in the Tiger Reserve.

Page 211. Table 6.1. Point 3 Redressal.

Comment: We do not agree. Impacts of vessel/dredging noise on river dolphins need to be studied further through focused studies. The methodological gaps in the current study are already elucidated in detail. Further, the speed restriction MUST apply to the entire river, because dolphins are present throughout.

We would like to also know who the stakeholders involved were in relation to dolphins and gharials, during the public consultations. If, only forest department officials were involved, then getting a fully representative idea of dolphin/gharial population size and distribution in the entire river would not be possible. This can be considered as a major gap in this study.

Similar comments as provided above apply to points 7 and 8 of Table 6.1.

Page 220: Point about aquatic sensitivity; Phase 2.

Comment: Here again the river dolphin and gharial have been completely confused by the EIA makers. The Gandak River in VTR is NOT the only area where gharials and river dolphins are found. Both these species are found all along the river. So the information in this part is wrong.

The same comment applies to part 2. Biological Environment under the remedial measures section of the Table on Pages 223 and 229 and to relevant sections from Page 253-274.

Further, what source was used to state that 'dolphin needs very shallow water for giving birth'? We have not heard of any such preference. Either an authorized source (paper, study report etc.) should be cited to back up this statement, or this wrong statement should be removed. We have seen dolphins give birth in deep river stretches also.

Page 284: …Development of NW-37 is beneficial for the economic development of Bihar as well as country and environment due to expected model shift of cargo movement from rail and road to IWT.

Comment: This claim that the development of NW-37 is beneficial for environment is unfounded. There is no evidence to back up this statement, and in fact, the impacts might be to the contrary as far as environmental benefit is concerned.

Recommendation: No further development of the project should be allowed unless studies experimentally showing that the ecological and environmental impacts of project activities such as dredging and channelization is compatible with ecological considerations that have been emphasized in our comments as well as the EIA itself. Furthermore navigability in the dry season should be ensured through a combination of ecologically sensitive release of water from the barrage rather than through dredging or sudden releases.