BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

WESTERN ZONE BENCH AT PUNE

INTERIM APPLICATION NO. 13 OF 2021

IN

ORIGINAL APPLICATION NO. 28 OF 2020 (WZ)

Sarang Yadwadkar & Ors …Applicants

Versus

Pune Municipal Corporation and Ors …Respondents

I N D E X

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Advocate for the Respondent No.6

BEFORE THE NATIONAL GREEN TRIBUNAL
WESTERN ZONE BENCH AT PUNE
I.A. No. 13 of 2021
IN
ORIGINAL APPLICATION NO. 28 OF 2020

Sarang Yadwakar & Ors. ...Applicants

Versus

Pune Municipal Corporation and Ors. ...Respondents

AFFIDAVIT-IN-REPLY ON BEHALF OF THE RESPONDENT NO.6 TO THE I.A. IN O.A. NO. 28/2020

I, Kumkum Mishra, the Senior AGM-Legal and authorised signatory of the Respondent No.6 – Maharashtra Metro Rail Corporation Limited having my office at Metro Bhawan, Opposite Deeksha Bhoomi, Ramdaspeth, Nagpur 440010 do hereby state on solemn affirmation as under :

1. I say that the Applicants have preferred an Interim Application in the present Original Application and I have perused the copy of the said Interim Application and the documents brought on record in the Interim Application and have understood the contents of the Interim Application. In response thereto, on the basis of the documents and information available in relation to the said issue, I am filing this present Affidavit-in-Reply to oppose the grant of any reliefs as sought by the Applicants and as prayed for in the present Interim Application. I crave leave to file a further and detailed Affidavit-in-Reply with the express permission of this Hon'ble Court.

2. At the outset, I deny each and every averment and allegation made in the present Interim Application, which is contrary to and/or inconsistent with what has been stated in the Affidavit-in-Reply filed to the Original Application No. 28 of 2020 and the present Affidavit-in-Reply and nothing stated in the present Interim Application under Reply shall be construed as an admission for the want of any specific and para-wise denial or non-traverse unless and until the same is specifically admitted hereinafter. I crave leave

Mrs. S. R. MATIA NOTARY GOVT. OF INDIA

to refer to and rely upon the pleadings taken by the answering Respondent in response to the earlier IA No. 83 of 2020 as a part and parcel of the present Affidavit-in-Reply. The answering Respondent denies the contents of the Interim Application especially those as regards the impact of the metro pillars, about the aspect of the fixation of flood lines (blue line), about the discharge in cusecs during the monsoons and about the veracity of the other similar allegations made. The answering respondent craves leave to file a para-wise and detailed affidavit in reply with the permission of this Hon'ble Court.

3. In the present Interim Application, the Applicants are basically seeking an order of stay on the construction of the metro based on the findings of the CWPRS report of January 2021 and further direction against the answering Respondents for not submitting the CWPRS report before the Tribunal. In response, I say and submit that the present Interim Application is not at all maintainable and does not plead the correct factual position which is as follows:

(i) I say that the Applicants had filed an Original Application bearing no. 67 of 2016 (renumbered as 130 of 2018) in May 2016 challenging the approx.1.5 km stretch of Metro corridor (Vanaz- Ramwadi) running through the Blue Line of river Mutha having two stations namely Deccan and Sambhaji Park in the city of Pune. The project at that time was at the inception stage and had not been started.

(ii) In the said OA, the Hon'ble Tribunal vide its order dated 21 September 2017 had proposed to appoint an Expert Committee in the field of Ecology, Hydrology and Water Pollution to study 1.5 KM stretch of River Mutha and assess Environmental Impact of construction of Metro Rail in that stretch. The Original Applicants were not averse to the appointment of such an Expert Committee. However, the answering Respondent was not agreeable to the proposal for appointment of Expert Committee. The Hon'ble Tribunal heard the arguments on appointment of Expert Committee on 10 October 2017 and passed an order dated 13 October 2017 thereby appointing an Expert Committee. The said Expert

Committee consisted of experts from the field of hydrology, ecology and biodiversity and Water Pollution and also NEERI, Maharashtra State Diversity Board, Maharashtra Pollution Control Board had one Senior Scientists each.

(iii) The said Expert Committee appointed by this Hon'ble Tribunal after studying the matter in detail and after inspecting the site have submitted its detailed report on 5 January 2018. In the said detailed report, the Expert Committee has already dealt with the issue which is subject matter of the present Original Application filed by the Applicants. The answering Respondent also agreed on 6 April 2018 to comply with the recommendations given by the Expert Committee in their report while implementing the Metro Rail Project which is ultimately a project of Central Government, State Government and the Municipal Corporations.

(iv) The said OA was then disposed of by the Hon'ble NGT (Principal Bench) by a Judgment dated 3 August 2018. The Hon'ble NGT in its judgment dated 3 August 2018 in Para 16 and 17 has made the following observations:

"16. In view of the above, we are of the opinion that it will not be in public interest to prohibit the project. However, the project may be completed by following all the safeguards suggested by the Expert Committee. We also direct that the Committee will inspect the ongoing project once in two months and if any further directions are given by the Committee, the Project Proponent will be bound by the same.

17. We also direct the Divisional Commissioner of Pune to associate with the Committee and supervise the project specially the environmental aspects. It will be open to the applicants or any other stakeholders to continue to give their suggestions to the Committee so that any damage to the environment can be prevented or minimized. In case it is found that the Project Proponents are not complying with the directions of the Expert Committee, the Committee will be at liberty to bring the same to the notice of this Tribunal by moving an appropriate application."

(v) Being aggrieved with the said Judgment, the Applicants thereafter carried the matter to the Hon'ble Apex Court and the Hon'ble Apex Court by its order dated 15 February 2019 has permitted the Applicants to raise his grievances before the Expert Committee constituted in the said matter and it is in accordance with this

GOVT. OF INDIA

order that the Applicants had approached the Expert Committee raising various grievances, principally against the report submitted by the Expert Committee on 5 January 2018 in view of the earlier order of the NGT.

(vi) From the record it appears that the Applicants' case is that their grievances were not addressed by the Expert Committee. And thus being aggrieved by the same, the Applicants filed the second Original Application No. 70 of 2019. The NGT thereafter by its order dated 5 November 2019, directed the Expert Committee to again hear the Applicants and consider their objections and pass a reasoned order. And thereafter it can be noticed that on 16 January 2020, the Applicants were called for submission of various documents and grievances by the Expert Committee.

(vii) I say that in view of the order of the NGT dated 3 August 2018, the Divisional Commissioner has been regularly supervising the Pune Metro project and in its fourth such meeting held on 20 November 2019, the Expert Committee has given various recommendations/directions to the answering Respondent. The said minutes are already annexed as Exhibit 2 to the Reply filed by the answering Respondent to the Original Application.

(viii) I say that accordingly the answering Respondent had initially already submitted all the details, but in accordance with the order of the NGT the Applicants were heard and the grievances raised by the Applicants were considered and on 21 May 2020, various recommendations were given by the Expert Committee to the answering Respondent which are from Page 57 to Page 63 of the present Original Application and which were also forming part of the minutes of meeting dated 20 November 2019. I say that the said directions have been assailed again by the Applicants as a final report in the third round of litigation being the present Original Application. I say that a bare perusal of the recommendations and the report at Page 62 will go on to reveal that the Applicants have totally

misconstrued the nature of the recommendations and has challenged the same by the preferring the present Original Application.

(ix) The answering Respondent submits that the Expert Committee has in the said report issued recommendations/directions and has called upon the answering Respondent to submit its say and to provide details about various parameters which are stated in the said report. One of the recommendations of the Expert Committee was that a fresh hydrodynamic study was required to assess the impact of metro piers, footings and pile cap on afflux and submergence. The said study was to be conducted by the Central Water and Power research Station (CWPRS), Pune. The answering Respondent states that thus without waiting for the said study by CWPRS, the report which is sought to be assailed cannot be called as a final report at all.

(x) I say that thereafter the third Original Application filed by the Applicants was listed on 7 July 2020 in which notice was issued to the Respondents and the Hon'ble Court was pleased to appoint yet another Committee consisting of Pune Municipal Corporation, Delhi Metro Rail Corporation, Maharashtra State Pollution Control Board and Maharashtra Metro Rail Corporation and directed them to submit a joint report within 3 weeks. The answering Respondent submits that this order is clearly contradictory to the earlier order of the Principal bench of the NGT as well as the Supreme Court and thus the answering Respondent has filed a Application No. 126 of 2020 seeking recall of the said order dated 7 July 2020. The said Interim Application has also been served on the Original Applicants.

(xi) The answering Respondent states that in the present Original Application the Applicants had already preferred an Interim Application No 83 of 2020 seeking a stay to the project. The answering Respondent has already filed a reply to the Original Application as well as Interim Application No 83 of 2020. In the said reply, the answering Respondent has specifically denied the arguments of the

Applicants that 50% of the metro piers had submerged during the 2019 floods when 45,474 cusecs water was released from the upstream dam. The other contention that the submergence of metro piers in 2020 began merely at release of 9,416 cusecs and 13,981 cusecs has also been denied. The answering Respondent had also placed before the Court the order passed by the Apex Court in the earlier round of litigation in which it was specifically stated that there was no stay on the project and the answering Respondent/Project Proponent was permitted to continue with the work.

(xii) The Hon'ble NGT after hearing the parties on 28 September 2020 has recorded the fact that the final Committee Report is awaited and that it would not be just and proper to intervene in the continuance of the project in light of order passed by the Hon'ble Apex Court. Hereto annexed and marked as **Exhibit 1** is a copy of the order passed by the NGT dated 28 September 2020.

(xiii) The answering Respondent states that thereafter the Central Water Power Research Station (CWPRS) has submitted its report to the Expert Committee in January 2021. Hereto annexed and marked as **Exhibit 2** is a copy of the final CWPRS Report along with corrigendum dated 23 February 2021. Thereafter the Expert Committee headed by the Divisional Commissioner which has been appointed by NGT itself has on 8 March 2021 considered the final CWPRS Report and given its recommendations on 12 May 2021. The answering Respondent submits that the Expert Committee in its meeting held on 8 March 2021 considered the study of CWPRS including the simulations studies to estimate afflux due to construction of metro piers along the Mutha river bank. The major findings of the studies which have been considered by the Committee are that the level of rise of water due to metro pillars even for 1,00,000 cusecs discharge would be only 216 mm at metro P152 and 241 mm at metro P DE1 respectively. The inundation (spread of water along both banks i.e. left bank plus

right bank) for discharge of one lakh cusecs would be insignificant (0.02 m) in the reach between Shivaji Bridge and Shinde Bridge. In the reach between Shinde Bridge and Metro pier DE8 the incremental increase inundation varies between 0.02 to 10 m. Further from DE8 to Baba Bhide Bridge the incremental inundation varies from 2.6 to 10.94 m (about 5 m on either bank). At 3 locations namely P159, P160 and Z Bridge the inundation is 22.2 m, 20.6 m and 29.8 m respectively. The incremental inundation extent of 55.76 m at pier No P167 is due to the specific topography at this location. There is a low level cross road connecting the river front road and Kelkar road at this location and water spreads along this road and hence the inundation extent at this particular location was higher. The Expert Committee has also considered that the CWPRS scientist has pointed out that the contribution of discharge from local catchment downstream of Khadakvasla Dam to Sangam Bridge will only yield about 8500 cusecs corresponding to the discharge of 90,000 cusecs and therefore even in a worst scenario the total discharge will not breach 100,000 cusecs and that the spillway design capacity of Khadakvasla dam is 97,000 cusecs only. The Expert Committee also noted that the CWPRS scientist had also pointed out in the last 56 years the discharge of 60,000 cusecs had only been breached 4 times and that discharge of 100,00 cusecs had not been breached even once. The Expert Committee has has stated that the Maharashtra Metro Rail Corporation through CWPRS has conducted all studies and submitted reports as directed by the Committee. The Committee stated that Maharashtra Metro Rail Corporation is taking utmost care during construction of the project and complying with the all the guidelines issued by the Expert Committee. It is important to note that the Expert Committee has specifically stated that there is no impediment in proceeding with the work by Maharashtra Metro Rail Corporation. Hereto annexed and marked as **Exhibit 3** is a copy of the recommendations/minutes of the Expert Committee meeting dated 8 March 2021 which have been received on 12 May 2021.

(xiv) The answering Respondent states that thus the pleadings of the Original Applicants in the present IA are contrary to the Expert Committee recommendations received on 12 May 2021 and thus it is clear that the contents of the Interim Application preferred by the Original Applicants cannot be relied upon. That in any event, the answering Respondent has always been willing and has been following the recommendations given by the experts in order to provide for a safe metro in Pune and that any sort of an injunction order is only going to cause a serious delay in the implementation of the project. The assertion of the Applicants that the impact of metro pillars would be huge and that there would be huge rise in total flood level after metro pillars are constructed is denied. The contention of the Applicants that even in the absence of metro piers the discharge of 1,00,000 cusecs would go 0.74 m above the red line generally is denied. Similarly the discharge of 60,000 cusecs would go 1.5 m above the blue line generally is also denied. The CWPRS Report on the contrary indicates that the rise in the levels above the red line and blue line are only in the vicinity of Shinde bridge and sufficient mitigating measures can be taken considering the topography of the area. In any case, the answering Respondent has already submitted to undertake measures so as to reduce the impact of concerns.

(xv) It is submitted that however, the approach of the Applicants is only to delay the project by one way or the other by preferring applications for stay on the same cause of action when the earlier stay application is already pending and thus the present application ought to be rejected. The relief sought in the present Application are akin to the reliefs sought in the Original Application and thus the Applicants are seeking interim reliefs which are actually in the nature of final reliefs.

(xvi) I say and submit that in the present Interim Application, the Applicants have basically prayed for granting a stay to the construction of the metro based on the findings of the CWPRS report of January 2021. The Applicants have also prayed for directions against the Respondent No.6 for not submitting the CWPRS report before the Hon'ble Tribunal. In this context, the answering Respondent would like to submit as follows:

a. That the Applicants are incorrectly interpreting the CWPRS report of January 2021. The answering Respondent submits that it has submitted the said report to the Expert Committee as well as to the Applicants and that the Expert Committee has already held a meeting on 8 March 2021 in pursuance of the CWPRS report and has given its recommendations on 12 May 2021 and therefore the allegations of the Applicants that the answering Respondent has not submitted the CWPRS are denied as being incorrect and wrong. The answering Respondent submits that despite the prevailing situation of covid pandemic, best efforts have been taken by the answering Respondent to see to it that the recommendations of the Expert Committee are duly complied with.

b. The answering Respondent submits that the interpretation sought to be given by the Applicants about the CWPRS report is incorrect. The CWPRS has conducted a simulations study about flood inundation extent for the discharge of 1,00,000 cusecs of water and for 60,000 cusecs of water from upstream around the 1.5 km stretch. The answering Respondent submits that though the discharge at 1,00,000 cusecs in accordance with the CWPRS report seems to be high at 3 metro piers – Pier 159 -22, Pier 160 – 20.61, Pier 167 checked road in right – 55.76, it is due to the topography of the said site and the answering Respondent would hasten to add that in the last more than 56 years there has been no discharge even once of 1,00,000 cusecs. The answering Respondent submits that the Expert Committee in its meeting has already noted the fact that the CWPRS scientist has also pointed out that in the last

more than 56 years, the discharge of 60,000 cusecs has been breached only 4 times and that 100,000 cusecs has not been breached even once. The Expert Committee in its meeting has also noted the response of the CWPRS that the incremental inundation to the extent of 55.76m at Pier no.167 is due to the specific topography at the location, there is a low-level cross road connecting the river-front road and Kelkar road at this location. Water is spreading along this road and hence higher inundation extent at this particular location is observed. The answering Respondent submits that this aspect has been completely overlooked by the Applicants. The answering Respondent submits that the Applicants have not even stated even once as to when the discharge has reached 1,00,000 cusecs (either in the present application or in the Original Application) and thus, the argument of the Applicants that the order of NGT dated 13 October 2017 needs to be revisited, is totally fallacious. It is also pertinent to note that even at a discharge of 1,00,000 cusecs, the inundation at other piers in the entire stretch in which the study has been conducted by CWPRS is insignificant. The Applicants have not brought on record any contrary data for the same.

c. Importantly, in accordance with the CWPRS report, it is clear that at the same 3 metro piers, the discharge at 60,000 cusecs shows the inundation to be insignificant. Pier 159 – 0.11, Pier 160 – 0.11 and Pier 167 checked road in right – 0.77 and thus it is clear that the inundation at 60,000 cusecs is almost insignificant. The same aspect has been noted in the recommendations/minutes of the Expert Committee meeting held on 8 March 2021 and received on 12 May 2021 and therefore, the answering Respondent ought to be permitted to continue with the project work in accordance with the schedule and by implementing the measures which the Expert Committee recommends.

d. The answering respondent submits that the present alignment is carefully selected and is statutorily approved and therefore the arguments of the Applicants contrary to the same are denied. The answering Respondent craves leave to refer to and rely upon the necessary and relevant project details as and when required.

(xvii) The answering Respondent submits that although the Applicants have cited various judgments in relation to seeking an injunction, it is submitted that in the facts of the present case, they are not applicable. The answering respondent repeats that it is implementing a project of great importance in Pune and is abiding by the conditions imposed by the Expert Committee. The answering Respondent denies all the contents of the Applicants and his interpretation regarding the CWPRS report.

(xviii) In any case, the answering Respondent submits that the CWPRS report was placed before the Expert Committee on 8 March 2021 and that the Expert Committee has been constituted by the Hon'ble National Green Tribunal and which has given its recommendations and views on the said aspect on 12 May 2021. The Committee has also considered the fact that even the Irrigation Department and Smart City Project have robust flood alarm and evacuation system to avoid loss of life and property. The Smart City Project has already identified the flood prone locations and areas to where people will be moved in case of floods. The answering respondent submits that therefore the report/recommendations of the Expert Committee dated 12 May 2021 have been placed on record. At this stage, the answering Respondent submits that therefore considering the same, it is just and necessary that the report of the Expert Committee be considered and only then further action may be taken. The answering Respondent submits that the balance of convenience is also in favour

of the answering Respondent and no prima facie loss or harm would be caused to the Applicants.

(xix) In any event it is submitted that in the state of Maharashtra to oversee the effect of floods and to see to it that the flood situation which occurred in Krishna and Bhima river basins in 2019, a Committee headed by a retired Secretary of Irrigation and Water Resources Department has been constituted. The said committee from time to time is also empowered to give suggestions so that flood like situations do not arise in future in the state of Maharashtra. In this context the said committee in its meeting on 12 March 2021 considered the aspect of inundation and afflux alongside Mutha river due to Metro construction from the representatives of CWPRS. Thereafter, the Chairman of the said Bhima Basin Flood Committee in its meeting on 22 March 2021 has also directed the answering Respondent to submit to it the CWPRS Report so that it can consider the same in its proper perspective. Accordingly, the Engineer from Irrigation and Water Resources Department has already written to the answering Respondent on 22 March 2021 asking for a copy of the CWPRS Report so as to ascertain the impact of Metro construction and conduct a study. Accordingly, on 23 March 2021 the answering Respondent has already submitted to it a copy of the CWPRS Report and currently its recommendations which will also be very useful are awaited. Hereto annexed and marked as **Exhibit 4** is a copy of the letter dated 22 March 2021 issued by the Engineer, Irrigation and Water Resources Department. Hereto annexed and marked as **Exhibit 5** is a copy of the letter dated 23 March 2021 issued by the answering Respondent.

(xx) The Answering Respondent further submits that the Applicants are trying to stall the project by using all means. As the project is foreign funded, Applicants have complained to the funding Agency, i.e European Investment Bank (EIB) against the project. The answering Respondent submits that the Applicants have already filed the present Original Application before this Court and even without waiting

for a decision on the same has complained to international agencies. The Applicants have also filed a Public Interest Litigation for the same cause of action in the High Court. All along, although the Applicants are categorically stating that they are not against the Metro however, the actions of the Applicants like complaining to the European Investment Bank or the Funding agency of the answering Respondent only go on to show the true intentions of the Applicants which is to stall the Metro Project. The answering Respondent submits that thus it is clear that the intent of the Applicants being such heavy costs should be imposed and saddled on the Applicants for abusing the process of court and for filing frivolous complaints. The answering Respondent submits that the Applicants have also preferred a PIL in the Hon'ble High Court on the same cause of action asking for an injunction till such time the NGT hears the matter and thus the Applicants are indulging in forum shopping.

(xxi) The answering respondent thus submits that in the light of above, the present Application being devoid of merits ought to be rejected.

Dated this 16 June 2021

Respondent No.6

Mrs. Kumkum Mishra
Sr. AGM (Legal)
Maharashtra Metro Rail Corp. Ltd.

Advocate for the Respondent No.6

NOTARIAL REG.
ENTRY No.
DATE 16/06/2021

Mrs. S. R. MATTA NOTARY NAGPUR DIST. (M.S.) REGD. No. 6776 GOVT. OF INDIA

SWORN BEFORE ME ON THIS 16th. DAY OF June 2021 AT NAGPUR BY SHRI / SMT./ KU. Kumkum Mishra. R/O NAGPUR WHO HAS BEEN IDENTIFIED BY SHRI / SMT. ..... ADVOCATE, NAGPUR.

Mrs. S. R. MATTA
ADVOCATE & NOTARY
918-B, Clarke Town, Nagpur-1

NOTARY MRS. S. R. MATTA NAGPUR DISTT. (M.S.) INDIA REGD. No. 6776 GOVT. OF INDIA

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VERIFICATION

I, Kumkum Mishra, the Senior AGM- Legal and the authorized signatory of the Respondent No.6 – Maharashtra Metro Rail Corporation Limited do hereby state on solemn affirmation that whatever is stated in the paras 1 to 3 is true and correct to the best of my own knowledge and based upon the documents available with me and which I believe to be true

Solemnly affirmed at Nagpur

Dated this16day of June 2021

Before me

Mrs. Kumkum Mishra
Sr. AGM (Legal)
Maharashtra Metro Rail Corp. Ltd.

NOTARIAL REG.
ENTRY No. 176
DATE 16/6/2021

Mrs. S. R. MATTA NOTARY GOVT. OF INDIA

SWORN BEFORE ME ON THIS 16 TH
DAY OF June 20 21 AT NAGPUR BY
SHRI / SMT./ KU. Kumkum Mishra
R/O NAGPUR WHO HAS BEEN IDENTIFIED BY
SHRI / SMT. .....
ADVOCATE, NAGPUR.

Mrs. S. R. MATTA
ADVOCATE & NOTARY
918-B, Clarke Town, Nagpur 10

Exhibit "1"

Item No. 2 (Pune Bench)

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

(Through Video Conferencing)

I.A. No. 83/2020
In
Original Application No. 28/2020 (WZ)

Sarang Yadwakar & Ors. Applicant(s)

Versus

Pune Municipal Corporation & Ors. Respondent(s)

Date of hearing: 28.09.2020

CORAM: HON'BLE MR. JUSTICE SHEO KUMAR SINGH, JUDICIAL MEMBER
HON'BLE DR. SATYAWAN SINGH GARBYAL, EXPERT MEMBER

For Applicant(s) : Mr. Ritwick Dutta, Ms. Kanika Sood and Mr. Maitreya Ghorpade, Advocates
Mr. Sarang Yadwadkar, Applicant-in-person

For Respondent (s): Mr. Pralhad D. Paranjape alongwith Mr. Manish Kelkar, Advocates for R-1 (PMC)
Mr. Sandip Thorat, Advocate for R-2
Ms. Manasi Joshi, Advocate for R-4
Mrs. Supriya Dangare, Advocate for Maharashtra Biodiversity Board
Mr. R.B. Mahabal, Advocate
Mr. Surendra Mishra, Senior Advocate alongwith Mr. Pralhad Paranjape, Mr. Kaustubh Deogade and Mr. Manish Kelkar, Advocates for R-6 (MMRC)

ORDER

1. Heard the learned counsel for the parties.

2. Learned counsel for the applicant has submitted that in light of the report and contents as mentioned in the application, interim order is required to be issued. The matter is already listed on 23.11.2020. The Committee by submitting interim report has sought some time to consider the various reports of experts and submit a final report.

3. Learned counsel appearing for Respondent No. 6 has submitted that the matter was agitated before this Tribunal by filing the original application which has been finally disposed off and certain directions were issued. The applicant has raised these questions before Apex Court and Apex Court disposed off the application finally. It is further argued that the Hon'ble Apex Court and this Tribunal in previous proceedings has expressed opinion not to intervene in the continuance of the project in public interest and issue certain directions by constituting a committee to monitor and the committee is monitoring it. It has further been argued that the Tribunal has directed the committee to consider the points and objections raised by the applicant and to consider and decide and to take further remedial actions for which the committee is considering and in light of the report of the committee remedial measures are being taken.

4. Accordingly, we are of the view that the request of the committee should be accepted and short time should be granted to submit a final report.

5. At this stage, we do not find out just and proper to intervene in the continuance of the project in light of the order passed by the Hon'ble Apex Court. The committee is directed to submit the report before the date of listing.

6. Put up on the date as already fixed i.e. 23.11.2020.

Sheo Kumar Singh, JM

Dr. Satyawan Singh Garbyal, EM

MN

CIN: U60100MH2015SGC265051
महा मेट्रो
PUNE METRO

महाराष्ट्र मेट्रो रेल कॉर्पोरेशन लिमिटेड
MAHARASHTRA METRO RAIL CORPORATION LIMITED
(भारत सरकार आणि महाराष्ट्र शासनाचा संयुक्त उपक्रम)
Joint Venture of Govt. of India & Govt. of Maharashtra
PUNE METRO RAIL PROJECT

Ref No.: Maha-Metro/Pune/EMD/C08 Date: 11th January, 2021

To,
Regional Deputy Director,
Municipality Administration branch
Office of Divisional Commissioner, Pune

Sub: Minutes of Meeting (MoM) dated 20/11/2019 issued by Divisional Commissioner vide No/NP-4/WS/909/2019 dated 16th December,2019 in matter of NGT Order dated 3rd August,2018 in Original Application No. 130 of 2018 (M.A. No. 343/2018, 344/2018, 345/2018 and 346/2018) (Earlier O.A. No. 67/2018 (WZ)

Dear Sir,

Reference to the above captioned subject, Maha-Metro was directed to conduct the Numerical Model Study from CWPRS and submit the report at earliest. In compliance to this condition Maha-Metro has awarded this study to CWPRS. The initial study was carried out and a technical note containing the afflux in Mutha River on introduction of Metro Piers was submitted and second part of the study on inundation was assured to be submitted shortly. The above referred initial report was submitted to your good office and also to the Expert Committee by Maha-Metro vide mail dated 4th August, 2020.

Now, The CWPRS has completed the study and submitted the final report containing the afflux and inundation both. The same report is herewith enclosed for your reference please.

11/01/21

(Ratnakar Pandey)
DGM/Environment
Maha-Metro Rail Corporation, Pune

Encl: CWPRS Technical Report no. 5889, January 2021

Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development and
Ganga Rejuvenation

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग

TECHNICAL REPORT NO. 5886
JANUARY 2021

MATHEMATICAL MODEL STUDIES OF RIVER MUTHA FOR MAHA-METRO RAIL CORPORATION LTD., PUNE

केन्द्रीय जल और विद्युत अनुसंधान शाला, पुणे
CENTRAL WATER AND POWER RESEARCH STATION, PUNE

A. K. AGRAWAL
Director

भारत सरकार
Government of India
जल शक्ति मंत्रालय
Ministry of Jal Shakti
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
Department of Water Resources, River Development and Ganga Rejuvenation
केन्द्रीय जल और विद्युत अनुसंधान शाला
खड़कवासला, पुणे - 411 024
Central Water & Power Research Station
Khadakwasla, Pune – 411 024

टेलीफोन : 020-24103331
फैक्स : 020-24381004
ई-मेल :n_isaac@cwprs.gov.in

No.HAPT/Maha-Metro/2021 -

Date : 11/01/2021

Shri Ratnakar Pandey
Deputy General Manager (Environment)
Maharashtra Metro Rail Corporation Ltd.
1st floor, The Orion Building, Arjun Mansukhani Marg,
Pune-411001

Sub : Mathematical Model Studies of River Mutha for Maha-Metro Rail Corporation Ltd. Pune.

Sir,

A Technical Report No. 5886 of January 2021 entitled "Mathematical Model Studies of River Mutha for Maha-Metro Rail Corporation Ltd. Pune" is enclosed in duplicate, for reference and record.

Kindly acknowledge the receipt.

Thanking you,

Yours faithfully,

Neena Isaac
11/01/2021

(Dr. (Mrs) Neena Isaac)
Scientist 'E'

GOVERNMENT OF INDIA

MINISTRY OF JAL SHAKTI

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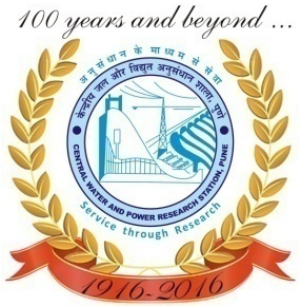

Reservoirs and Appurtenant Structures

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MATHEMATICAL MODEL STUDIES OF RIVER MUTHA FOR MAHA – METRO RAIL CORPORATION LTD. PUNE

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Director

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TITLE: MATHEMATICAL MODEL STUDIES OF RIVER MUTHA FOR MAHA – METRO RAIL CORPORATION LTD. PUNE

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Synopsis

Maharashtra Metro Rail Corporation Limited (MMRCL) is a joint venture company of Govt. of India and Govt. of Maharashtra, established for the purpose of implementation of Pune Metro Rail Project. The total length of Pune Metro Rail Project is 31.25 km of which a stretch of 1.45 km passes along the left bank of Mutha River. As per the design, 61 Piers will be constructed along the left bank of Mutha River. MMRCL approached Central Water and Power Research Station (CWPRS) to conduct hydrodynamic model studies to estimate the afflux in Mutha River due to the construction of metro pier and allied structures. One dimensional mathematical model studies for river Mutha were carried out. The numerical model of river Mutha covering a reach of about 15.0 km from Khadakwasla dam to Sangam near confluence of Mutha River with Mula River was developed using HEC-RAS software. Simulations were carried out for Mutha River considering existing bridges without Metro piers and then including Metro piers to find out the afflux for the discharges of 60,000 ft^3/s and 1,00,000 ft^3/s. Further, same set of experiments were carried out using Aerial Survey data. The maximum afflux for the discharge of 1,00,000 ft^3/s in the reach near Sambhaji bridge reduces to 216 from 380 mm when the extended cross sections are taken into account. For discharge of 60,000 ft^3/s the afflux in same reach reduces to 193 mm from 290 mm. Inundation depths and the extent of inundation were also calculated considering SRTM DEM and the DEM data provided by the projects authorities.

Key words: Afflux, Bridges, Piers, Mutha River, One dimensional model, HEC-RAS, RAS Mapper

NUMERICAL MODEL STUDIES FOR RIVER MUTHA FOR MAHA METRO RAIL CORPORTION LTD. (MMRCL), PUNE

Technical Report No.: 5886 **Month: January 2021**

1.0 INTRODUCTION

Maharashtra Metro Rail Corporation Limited (MMRCL) is a joint venture company of Govt. of India and Govt. of Maharashtra, established for the purpose of implementation of Pune Metro Rail Project. The total length of Pune Metro Rail Project is 31.25 km of which a stretch of 1.45 km passes along the left bank of Mutha river. As per the design, 61 Piers will be constructed along the left bank of Mutha river. MMRCL approached Central Water and Power Research Station (CWPRS) to conduct hydrodynamic model studies to estimate the afflux in Mutha river due to the construction of metro pier and allied structures. This technical report describes the numerical model studies conducted to determine the afflux along Mutha river due to the construction of metro piers. Numerical model simulations were conducted for various discharge conditions.

2.0 STUDY AREA

The study area is a reach of Mutha river passing through Pune city. The Mutha river is a part of Bhima basin which is a sub-basin of river Krishna. The Mutha river originates from the Sahyadri ranges and flows in the South-East direction. The flows in the Mutha river is controlled by the releases from the Khadakwasla dam located about 10 km upstream of Pune city area. River Mutha is flowing through the heart of Pune city and have confluence with river Mula about 15 km downstream of Khadakwasla dam. The river is known as Mula-Mutha downstream of this confluence. The river Mula-Mutha continues to flow in South-East direction and have confluence with river Bhima near village Pargaon at about 80 km downstream of Khadakwasla dam. The 15 km reach of Mutha river from Khadakwasla dam to its confluence with Mula river in Pune city is considered in the present study (Figure 1a). Pune city is spread along both the banks of Mutha river and there are about 16 bridges across the river in the study reach. MMRCL proposes to construct Pune Metro Rail Project for a length of about 31.25 km out of which a stretch of about 1.45 km length is passing along the left bank flood plain of Mutha river in the city area (Figure 1b).

3.0 TERMS OF REFERENCE

1. Estimation of afflux at each bridge for two river discharges of 60,000 ft^3/s and 1,00,000 ft^3/s.
2. Inundation of riverbanks caused by afflux

4.0 DATA REQUIRED FOR THE STUDIES

The basic data required for the studies include

(i) Topographic data in the form of river plan and cross sections
(ii) Hydraulic data in the form of discharge and water level/rating curve
(iii) Structural data of the bridges, causeways and metro piers in the form of plan, elevation and sections

The data received from the project were reviewed and observations along with data used in the studies are given below.

4.1 Topographic Data

Geometric data of the river in the form of river plan, cross sections and L-section were provided by MMRCL. The cross sections of river Mutha covering a reach of about 15.0 km from Khadakwasla dam to Sangam near confluence of Mutha river with Mula river were made available. The cross sections of the river were taken at an interval of 30 m in the study reach. The representative cross sections in the study reach are shown in Figure 2.

4.2 Hydraulic Data

The MMRCL provided the water surface profiles for Mutha river published by Water Resource Department, Government of Maharashtra in the study reach for the two river discharges of 60,000 ft^3/s (Blue line) and 1,00,000 ft^3/s (Red line).

4.3 Structural Data

The MMRCL provided the details of the bridges across the Mutha river in the study reach. Project Authorities also provided the structural details of Metro pier and pier cap along with the alignment of Metro line passing through the Mutha river flood plain.

5.0 MATHEMATICAL MODEL

A number of commercial or free numerical models are available which can simulate hydrodynamic flow routing along with the structural operations. The selection of the model depends on the objectives of the study, availability of data and computational resources. HEC-RAS 5.0.7 developed by the U.S. Army Corps of Engineers at the Army's Hydrologic Engineering Centre is extensively used all over world for simulating hydrodynamic flow routing. Hence, the same software was selected for hydrodynamic simulations in the present studies. The main input data required for HEC-RAS model include cross-sections of the river reach, gauge-discharge data, structural data etc.

The numerical model of river Mutha covering a reach of about 15.0 km from Khadakwasla dam to Sangam near confluence of Mutha river with Mula river was developed using HEC-RAS software. The river geometry was reproduced in the model using the cross section data supplied by the Project Authorities (Figure 3). The steady state simulations were performed by imposing the discharge as the upstream boundary and water levels obtained from the Irrigation data as the downstream boundary. The Manning 'n' of 0.021 was used in simulations studies based on the existing river condition. Details of the simulations performed along with the results are described in the following paragraphs.

5.1 Simulation studies without metro piers

Initial simulation studies were conducted to obtain water surface elevations without the Metro piers. The existing bridges in the river Mutha were incorporated in the model. The studies were conducted for two river discharges of 60,000 ft^3/s and 1,00,000 ft^3/s corresponding to blue and red line respectively. The results presented in the report are restricted to the study reach of river Mutha between Garware bridge and Shivaji bridge covering the Metro Piers and infrastructure. The computed water surface elevations were compared with blue line and red line provided by the Irrigation department. The results are plotted in the Figure 4. The simulated water surface elevations are above the red line in the reach between Sambhaji bridge and Shivaji bridge for the discharge of 1,00,000 ft^3/s. This may be attributed to the restricted cross section data. The cross sections may not be covering the entire flood plain where the water is likely to spread for larger area along both the banks thereby reducing the flood levels in actual site conditions. The representation of some of the bridge data in the model may also be incorrect. It was observed that the computed water surface elevation is about 0.74 m above the red line near/in the vicinity of Shinde bridge. The results obtained were also compared with the blue line. Similar trend as described above is observed for this

condition also, wherein simulated water surface elevations are above the blue line provided by the Irrigation Department. The computed water surface profile is about 1.5 m above the blue line near/in the vicinity of Shinde Bridge.

5.2 Simulation studies with metro piers

The metro pier and related infrastructure works were also incorporated in the model. These simulations indicate the afflux induced due to construction of the Metro piers. Figure 5 shows the Metro pier near the Sambhaji Bridge and Figure 6 shows metro pier with the cap protruding above the ground surface near Gadgil (Z) Bridge incorporated in the model. The simulations were conducted for two river discharges of 60,000 and 1,00,000 ft^3/s. The computed water surfaces from these simulations were compared with the previously simulated water surface elevations.

The results are plotted in the Figure 7(a) and (b) for the discharge of 1,00,000 ft^3/s. The water surface elevations and afflux are given in Table 1. It was observed that in the study reach, afflux varies from 50 to 100 mm in the reach between Shivaji and Shinde bridges. Further in the upstream reach between Shinde bridge and Metro pier DE 8, afflux varies between 150 to 250 mm. The afflux upstream of the Baba Bhide bridge is in the range of 340 to 350 mm with the maximum afflux of 380 mm observed at pier No. P152.

The results for the discharge of 60,000 ft^3/s are also plotted in the Figure 8(a) and (b). The water surface elevations and afflux are given in Table 2. It was observed that in the study reach, afflux is the range of 60 to 100 mm in the reach between Shivaji and Shinde bridges. Further in the upstream reach between Shinde bridge and Metro pier DE 8 afflux varies between 150 to 240 mm. The afflux upstream of the Baba Bhide bridge is in the range of 200 to 250 mm with the maximum afflux of 290 mm observed at pier No. P153.

5.3 Additional simulations with aerial survey data

The results of the initial simulations with available data were discussed in the meeting held at Divisional Commissioner Office on 24.09.2020. The issue of the restricted cross sections was discussed during the meeting. The cross section data used in the studies were cross verified with the Irrigation Department to check the width of cross sections. It was found that the data used in the model is in agreement with the Irrigation data. It was decided to conduct additional survey covering both the banks of river Mutha to overcome the problem of restricted cross section data. Owing to time restriction, aerial survey using the drone was

conducted by MMRCL. This data was provided to CWPRS to utilize in further studies. The data was provided in the cross section (Figure 9) and Digital Elevation Model (DEM) format.

5.3.1 Simulation studies using aerial survey data and existing bridges

The cross sections obtained from the aerial survey was incorporated in the model. The old cross sections provided by the Irrigation Department in the reach between the chainage 11430 m to 13800 m were replaced with cross sections obtained from the aerial survey. The simulations were performed for the discharges of 60000 ft^3/s and 1,00,000 ft^3/s corresponding to blue and red line respectively. The results are plotted in Figure 10 and given in Table 3 and Table 4. The water level in the Metro pier reach varies from 546.13 m to 547.50 m for the discharge of 60000 ft^3/s and from 548.67 m to 549.68 m for the discharge of 1,00,000 ft^3/s.

5.3.2 Simulation studies using aerial survey data along with metro piers

The cross sections obtained from the aerial survey was incorporated in the model. The old cross section data provided by the Irrigation Department in the reach between the chainage 11430 m to 13800 m was replaced with cross sections obtained from the aerial survey. The simulations were performed for the discharges of 60000 ft^3/s and 1,00,000 ft^3/s corresponding to blue and red line respectively. The results are plotted in Figure 11 and given in Table 3 and Table 4. The water level in the Metro pier reach varies from 546.13 m to 547.70 m for the discharge of 60000 ft^3/s and from 548.67 m to 549.90 m for the discharge of 1,00,000 ft^3/s.

The water surface profiles for the discharge of 1,00,000 ft^3/s with and without the Metro piers are plotted in the Figure 11(a) and Figure 11(b). The water surface elevations and afflux at bridges and Metro piers are given in Table 5. The results indicate that there is reduction in the afflux in the study reach because of the extended cross sections obtained from aerial survey. The afflux is lowered by an average of about 50 mm in the reach between Shivaji and Shinde bridge and the afflux at present with extended cross sections is in the range of 0 to 30 mm. In the reach between Shinde bridge and Metro pier DE 8, the afflux is reduced by an average of about 80 mm and afflux at present is in the range of 30 to 180 mm. The afflux is reduced by about 120 mm in the reach upstream of Baba Bhide bridge. The afflux observed at P152 with extended cross sections is 216 mm which is less than previously computed value of 380 mm.

The water surface profiles for the discharge of 60,000 ft^3/s with and without the Metro piers are plotted in the Figure 12(a) and Figure 12(b). The water surface elevations and afflux at bridges and Metro piers are given in Table 6. The results indicate that there is reduction in the afflux in the study reach because of the extended cross sections obtained from aerial survey. The afflux is lowered by an average of about 60 mm in the reach between Shivaji and Shinde bridge and the afflux at present with extended cross sections is in the range of 0 to 23 mm. In the reach between Shinde bridge and Metro pier DE 8, the afflux is reduced by an average of about 50 mm and afflux at present is in the range of 23 to 202 mm. The afflux is reduced by about 40 mm in the reach upstream of Baba Bhide bridge. The afflux observed at P152 with extended cross sections is 193 mm which is less than previously computed value of 270 mm.

5.4 Flood inundation mapping

Water surface profiles were computed for the discharges of 60,000 ft^3/s (Blue line) and 1,00,000 ft^3/s (Red line) using the numerical model. The inundation depths were computed based on the STRM DEM (30 m grid) downloaded from the USGS website. The inundation map generated is presented in Figure 13 to Figure 24. The inundation map overlaid on Google Map covering the entire study reach and for different stretches are presented in Figure 13 to Figure 18. The inundation map overlaid on SRTM terrain map covering the entire study reach and for different stretches are presented in Figure 19 to Figure 24.

Subsequently, the inundation depths were computed based on the DEM generated from the aerial survey data. The aerial survey data were provided for a reach of about 2.5 km covering the reach between S M Joshi bridge and Shivaji bridge (reach where Metro piers are located along the river flood plain).

The inundation area for the flood discharge of 1,00,000 ft^3/s with and without the Metro piers are plotted in the Figure 25. The inundation area at bridges and Metro piers are given in Table 7. The results indicate that the inundation area in the reach between Shivaji and Shinde bridge in the range of 0 to 0.02 m. In the reach between Shinde bridge and Metro pier DE 8, the inundation area varies from 0.02 m to 10.01 m. The inundation area in the reach between Metro pier DE 8 and Baba Bhide bridge is in the range of 3.06 m to 10.94 m. The inundation area in the reach upstream of Baba Bhide bridge varies from 10.94 m to 2.66

m. In the reach near the Metro piers P159, P160 and Z bridge, inundation area is higher and is in the range of 20 m to 30 m.

The inundation area for the flood discharge of 60,000 ft^3/s with and without the Metro piers are plotted in the Figure 26. The inundation area at bridges and Metro piers are given in Table 8. The results indicate that the inundation area in the reach between Shivaji and Shinde bridge in the range of 0 to 0.01 m. In the reach between Shinde bridge and Metro pier DE 8, the inundation area varies from 0.01 m to 2.27 m. The inundation area in the reach between Metro pier DE 8 and Baba Bhide bridge is in the range of 2.27 m to 11.44 m. The inundation area in the reach upstream of Baba Bhide bridge varies from 11.44 m to 0.79 m. In the reach near Bhide bridge and Metro piers P162 and P163 inundation area is higher and is in the range of about 10 m to 12 m.

The extent of inundation and its accuracy is dependent on the underlying DEM data. Hence, the extent of inundation may vary depending on the underlying DEM.

6.0 CONCLUSIONS

The numerical model of river Mutha covering a reach of about 15.0 km from Khadakwasla dam to Sangam near confluence of Mutha river with Mula river was developed using HEC-RAS 5.0.7. Simulations were carried out for the discharges of 60,000 ft^3/s and 1,00,000 ft^3/s to compute the water surface profiles under existing conditions and also by incorporating the Metro piers to estimate the afflux.

- It was observed that the maximum afflux for the discharge of 1,00,000 ft^3/s is about 380 mm in the reach near Sambhaji bridge. This afflux is reduced to 216 mm when the extended cross sections are taken into account.
- It was observed that the maximum afflux for the discharge of 60,000 ft^3/s is about 290 mm in the reach upstream of Sambhaji bridge near pier number P153. This afflux is reduced to 193 mm when the extended cross sections are taken into account.
- The inundation depths were computed based on the STRM DEM (30 m grid) downloaded from the USGS website and inundation maps were prepared for the entire study reach. The extent of inundation and its accuracy is dependent on the underlying DEM data. Hence, the extent of inundation may vary depending on the underlying DEM.

- Subsequently the inundation depths were computed based on the DEM data collected by aerial survey for limited reach of 2.5 Km. Flood extent was overlaid on Google image.

Table 1: Water Surface Elevations for the discharge of of 1,00,000 ft^3/s

Brigdes and Peir Names	Water Surface Elevation before introduction of Metro Pier	Water Surface Elevation after introduction of Metro Pier	Afflux
	(m)	(m)	(mm)
Nanded Shivne	559.9	559.9	0
NH 4 Vadgaon	555.23	555.27	40
Rajaram	553.1	553.21	110
Mhatre	551.13	551.38	250
SM Joshi	550.56	550.93	370
YB Chavan	550.47	550.83	360
P152	550.36	550.74	380
P153	550.39	550.7	310
P154	550.16	550.49	330
P155	550.14	550.47	330
Sambhaji/ Lakadi	550.12	550.45	330
P156	550.12	550.45	330
P157	550.06	550.39	330
P158	550.02	550.35	330
P159	549.99	550.33	340
P160	550	550.33	330
Z bridge	549.97	550.3	330
P161	549.93	550.27	340
P162	549.91	550.24	330
P163	549.8	550.14	340
Bhide	549.79	550.13	340
DE1	549.78	550.13	350
DE2	549.78	550.12	340
DE3	549.75	550.08	330
DE4	549.76	550.09	330
DE5	549.71	550.04	330
DE6	549.77	550.08	310
DE7	549.79	550.04	250
DE8	549.65	549.9	250
DE9	549.67	549.9	230
DE10	549.62	549.86	240
P164	549.67	549.89	220
P165	549.65	549.88	230
P166	549.42	549.67	250
P167	549.43	549.68	250

P168	549.46	549.7	240
P169	549.29	549.55	260
P170	549.27	549.53	260
P171	549.38	549.61	230
P172	549.16	549.39	230
P173	549.02	549.26	240
P174	549.1	549.32	220
P175	549.13	549.35	220
P176	549.06	549.28	220
SP1	549.11	549.31	200
SP2	549.1	549.3	200
SP3	548.99	549.19	200
SP4	549.06	549.24	180
SP5	549.07	549.24	170
SP6	549.03	549.19	160
SP7	549.08	549.23	150
SP8	549.1	549.24	140
SP9	549.11	549.25	140
SP10	548.98	549.12	140
P177	549.03	549.15	120
P178	548.96	549.08	120
P179	548.97	549.08	110
P180	549.01	549.12	110
P181	548.82	548.93	110
P182	548.84	548.96	120
Shinde	548.81	548.91	100
P183	548.74	548.85	110
P184	548.63	548.74	110
P185	548.52	548.63	110
P186	548.54	548.63	90
P186a	548.53	548.61	80
Causeway	548.6	548.67	70
P187	548.62	548.68	60
P188	548.3	548.35	50
P189	548.53	548.55	20
P190	548.48	548.49	10
P191	548.33	548.34	10
Shivaji	548.34	548.34	0
Dengale	547.91	547.91	0
Wellesely	547.07	547.07	0
Railway	547.02	547.02	0
Sangam/RTO	546.86	546.86	0

Table 2: Water Surface Elevations for the discharge of 60,000 ft^3/s

Brigdes and Peir Names	Water Surface Elevation before introduction of Metro Pier	Water Surface Elevation after introduction of Metro Pier	Afflux
	(m)	(m)	(mm)
Nanded Shivne	558.18	558.18	0
NH 4 Vadgaon	553.35	553.35	0
Rajaram	550.7	550.75	50
Mhatre	549.19	549.31	120
SM Joshi	548.48	548.71	230
YB Chavan	548.41	548.67	260
P152	548.31	548.58	270
P153	548.29	548.58	290
P154	548.33	548.55	220
P155	548.12	548.36	240
Sambhaji/ Lakadi	548.11	548.35	240
P156	548.08	548.32	240
P157	548.06	548.31	250
P158	548.03	548.28	250
P159	548	548.25	250
P160	547.98	548.23	250
Z bridge	547.99	548.23	240
P161	547.97	548.22	250
P162	547.93	548.18	250
P163	547.91	548.16	250
Bhide	547.85	548.1	250
DE1	547.83	548.09	260
DE2	547.8	548.06	260
DE3	547.78	548.04	260
DE4	547.77	548.02	250
DE5	547.77	548.02	250
DE6	547.73	547.98	250
DE7	547.74	547.99	250
DE8	547.77	547.97	200
DE9	547.66	547.87	210
DE10	547.68	547.88	200
P164	547.66	547.86	200
P165	547.67	547.86	190
P166	547.64	547.84	200
P167	547.43	547.66	230

P168	547.46	547.67	210
P169	547.49	547.69	200
P170	547.26	547.5	240
P171	547.23	547.46	230
P172	547.34	547.54	200
P173	547.23	547.42	190
P174	547.07	547.27	200
P175	547.12	547.31	190
P176	547.16	547.34	180
SP1	547.15	547.32	170
SP2	547.17	547.33	160
SP3	547.17	547.32	150
SP4	547.09	547.24	150
SP5	547.05	547.21	160
SP6	547.1	547.25	150
SP7	547.05	547.19	140
SP8	547.11	547.24	130
SP9	547.1	547.23	130
SP10	547.11	547.24	130
P177	546.98	547.09	110
P178	547.03	547.14	110
P179	546.98	547.09	110
P180	546.99	547.09	100
P181	547	547.09	90
P182	546.89	546.98	90
Shinde	546.88	546.97	90
P183	546.86	546.94	80
P184	546.78	546.87	90
P185	546.72	546.81	90
P186	546.62	546.72	100
P186a	546.64	546.73	90
Causeway	546.63	546.71	80
P187	546.68	546.74	60
P188	546.67	546.73	60
P189	546.28	546.35	70
P190	546.54	546.54	0
P191	546.37	546.37	0
Shivaji	546.24	546.24	0
Dengale	545.74	545.74	0
Wellesely	544.57	544.57	0
Railway	544.56	544.56	0
Sangam/RTO	544.33	544.33	0

Table 3: Water Surface Elevations for the discharge of 1,00,000 ft^3/s EXTENDED CS

Brigdes and Peir Names	Water Surface Elevation Before introduction of Metro Pier	Water Surface Elevation After introduction of Metro Pier	Afflux
	(m)	(m)	(mm)
Nanded shivne bridge	559.936	559.936	0
NH4 1	555.268	555.279	11
Rajaram	553.206	553.243	37
Mhatre	550.514	550.654	140
SM Joshi	549.924	550.132	208
YB Chavan	549.84	550.045	205
P152	549.683	549.899	216
P153	549.613	549.831	218
P154	549.585	549.802	217
P155	549.583	549.795	212
Sambhaji/ Lakadi	549.471	549.691	220
P156	549.458	549.677	219
P157	549.466	549.683	217
P158	549.457	549.672	215
P159	549.47	549.681	211
P160	549.464	549.671	207
Z bridge	549.408	549.624	216
P161	549.423	549.635	212
P162	549.432	549.641	209
P163	549.423	549.634	211
Bhide	549.419	549.629	210
DE1	549.347	549.562	215
DE2	549.345	549.557	212
DE3	549.343	549.55	207
DE4	549.27	549.466	196
DE5	549.283	549.476	193
DE6	549.278	549.468	190
DE7	549.281	549.467	186
DE8	549.269	549.452	183
DE9	549.265	549.445	180
DE10	549.237	549.418	181
P164	549.229	549.407	178
P165	549.195	549.372	177
P166	549.186	549.36	174

P167	549.164	549.34	176
P168	549.138	549.307	169
P169	549.052	549.208	156
P170	549.053	549.201	148
P171	549.046	549.191	145
P172	549.031	549.173	142
P173	549.021	549.16	139
P174	549.014	549.142	128
P175	548.993	549.116	123
P176	548.964	549.081	117
SP1	548.94	549.053	113
SP2	548.943	549.044	101
SP3	548.933	549.03	97
SP4	548.94	549.031	91
SP5	548.936	549.017	81
SP6	548.893	548.97	77
SP7	548.883	548.957	74
SP8	548.885	548.953	68
SP9	548.875	548.939	64
SP10	548.918	548.973	55
P177	548.912	548.963	51
P178	548.909	548.958	49
P179	548.9	548.946	46
P180	548.822	548.865	43
P181	548.844	548.882	38
P182	548.808	548.842	34
Shinde	548.804	548.834	30
P183	548.755	548.785	30
P184	548.751	548.777	26
P185	548.778	548.798	20
P186	548.762	548.779	17
P186a	548.756	548.77	14
Causeway	548.722	548.735	13
P187	548.693	548.707	14
P188	548.636	548.647	11
P189	548.675	548.682	7
P190	548.67	548.673	3
P191	548.665	548.666	1
Tilak	548.56	548.56	0
Shivaji	548.076	548.076	0
Dengle/ Kumbharwada new	547.598	547.598	0

Wellesely	547.19	547.19	0
Railway	547.054	547.054	0
Sangam/RTO	546.956	546.956	0

Table 4: Water Surface Elevations for the discharge of 60,000 ft^3/s EXTENDED CS

Brigdes and Peir Names	Water Surface Elevation before introduction of Metro Pier	Water Surface Elevation after introduction of Metro Pier	Afflux
	(m)	(m)	(mm)
Nanded shivne bridge	558.278	558.278	0
NH4 1	553.33	553.331	1
Rajaram	550.764	550.778	14
Mhatre	548.548	548.615	67
SM Joshi	547.791	547.947	156
YB Chavan	547.677	547.849	172
P152	547.504	547.697	193
P153	547.434	547.635	201
P154	547.407	547.609	202
P155	547.405	547.603	198
Sambhaji/ Lakadi	547.319	547.529	210
P156	547.287	547.5	213
P157	547.253	547.468	215
P158	547.254	547.464	210
P159	547.256	547.462	206
P160	547.25	547.452	202
Z bridge	547.183	547.395	212
P161	547.16	547.377	217
P162	547.129	547.354	225
P163	547.115	547.341	226
Bhide	547.107	547.332	225
DE1	547.031	547.272	241
DE2	547.028	547.266	238
DE3	547.023	547.255	232
DE4	547.006	547.215	209
DE5	547.008	547.214	206
DE6	547.002	547.204	202
DE7	547.002	547.201	199
DE8	546.958	547.16	202
DE9	546.95	547.15	200
DE10	546.935	547.129	194
P164	546.926	547.117	191
P165	546.845	547.036	191
P166	546.833	547.02	187
P167	546.837	547.015	178

P168	546.819	546.985	166
P169	546.763	546.915	152
P170	546.752	546.901	149
P171	546.705	546.855	150
P172	546.676	546.824	148
P173	546.662	546.808	146
P174	546.587	546.739	152
P175	546.597	546.741	144
P176	546.601	546.737	136
SP1	546.524	546.657	133
SP2	546.52	546.633	113
SP3	546.507	546.617	110
SP4	546.5	546.599	99
SP5	546.5	546.581	81
SP6	546.387	546.467	80
SP7	546.371	546.448	77
SP8	546.375	546.446	71
SP9	546.356	546.422	66
SP10	546.424	546.475	51
P177	546.41	546.456	46
P178	546.406	546.45	44
P179	546.409	546.448	39
P180	546.394	546.43	36
P181	546.396	546.428	32
P182	546.358	546.386	28
Shinde	546.352	546.375	23
P183	546.291	546.316	25
P184	546.285	546.305	20
P185	546.303	546.315	12
P186	546.288	546.296	8
P186a	546.281	546.286	5
Causeway	546.2	546.205	5
P187	546.133	546.14	7
P188	546.104	546.111	7
P189	546.124	546.128	4
P190	546.138	546.14	2
P191	546.131	546.131	0
Tilak	546.066	546.066	0
Shivaji	545.984	545.984	0
Dengle/ Kumbharwada new	545.37	545.37	0
Wellesely	544.685	544.685	0

Railway	544.585	544.585	0
Sangam/RTO	544.396	544.396	0

Table 5: Water Surface Elevations and comparison of afflux for the discharge of 1,00,000 ft^3/s

Brigdes and Peir Names	Chainage from Khadakwasla Dam	old survey			New (aerial) survey		
		W.S. Elev Before introduction of Metro Pier	W.S. Elev After introduction of Metro Pier	Afflux	W.S. Elev Before introduction of Metro Pier	W.S. Elev After introduction of Metro Pier	Afflux
		(m)	(m)	(mm)	(m)	(m)	(mm)
Nanded shivne bridge	3300	559.9	559.9	0	559.936	559.936	0
NH4 1	6270	555.23	555.27	40	555.268	555.279	11
Rajaram	9240	553.1	553.21	110	553.206	553.243	37
Mhatre	10860	551.13	551.38	250	550.514	550.654	140
SM Joshi	11590	550.56	550.93	370	549.924	550.132	208
YB Chavan	11790	550.47	550.83	360	549.84	550.045	205
P152	11940	550.36	550.74	380	549.683	549.899	216
P153	11970	550.39	550.7	310	549.613	549.831	218
P154	12000	550.16	550.49	330	549.585	549.802	217
P155	12020	550.14	550.47	330	549.583	549.795	212
Sambhaji/ Lakadi	12030	550.12	550.45	330	549.471	549.691	220
P156	12060	550.12	550.45	330	549.458	549.677	219
P157	12100	550.06	550.39	330	549.466	549.683	217
P158	12120	550.02	550.35	330	549.457	549.672	215
P159	12150	549.99	550.33	340	549.47	549.681	211
P160	12180	550	550.33	330	549.464	549.671	207
Z bridge	12192	549.97	550.3	330	549.408	549.624	216
P161	12210	549.93	550.27	340	549.423	549.635	212
P162	12230	549.91	550.24	330	549.432	549.641	209
P163	12240	549.8	550.14	340	549.423	549.634	211
Bhide	12270	549.79	550.13	340	549.419	549.629	210
DE1	12300	549.78	550.13	350	549.347	549.562	215
DE2	12314	549.78	550.12	340	549.345	549.557	212
DE3	12327	549.75	550.08	330	549.343	549.55	207
DE4	12330	549.76	550.09	330	549.27	549.466	196
DE5	12342	549.71	550.04	330	549.283	549.476	193
DE6	12360	549.77	550.08	310	549.278	549.468	190
DE7	12390	549.79	550.04	250	549.281	549.467	186
DE8	12393.6	549.65	549.9	250	549.269	549.452	183
DE9	12420	549.67	549.9	230	549.265	549.445	180
DE10	12428.6	549.62	549.86	240	549.237	549.418	181

P164	12450	549.67	549.89	220	549.229	549.407	178
P165	12466.1	549.65	549.88	230	549.195	549.372	177
P166	12480	549.42	549.67	250	549.186	549.36	174
P167	12510	549.43	549.68	250	549.164	549.34	176
P168	12540	549.46	549.7	240	549.138	549.307	169
P169	12570	549.29	549.55	260	549.052	549.208	156
P170	12600	549.27	549.53	260	549.053	549.201	148
P171	12630	549.38	549.61	230	549.046	549.191	145
P172	12660	549.16	549.39	230	549.031	549.173	142
P173	12690	549.02	549.26	240	549.021	549.16	139
P174	12720	549.1	549.32	220	549.014	549.142	128
P175	12750	549.13	549.35	220	548.993	549.116	123
P176	12780	549.06	549.28	220	548.964	549.081	117
SP1	12810	549.11	549.31	200	548.94	549.053	113
SP2	12820	549.1	549.3	200	548.943	549.044	101
SP3	12830	548.99	549.19	200	548.933	549.03	97
SP4	12840	549.06	549.24	180	548.94	549.031	91
SP5	12870	549.07	549.24	170	548.936	549.017	81
SP6	12880	549.03	549.19	160	548.893	548.97	77
SP7	12900	549.08	549.23	150	548.883	548.957	74
SP8	12915	549.1	549.24	140	548.885	548.953	68
SP9	12930	549.11	549.25	140	548.875	548.939	64
SP10	12945	548.98	549.12	140	548.918	548.973	55
P177	12960	549.03	549.15	120	548.912	548.963	51
P178	12990	548.96	549.08	120	548.909	548.958	49
P179	13020	548.97	549.08	110	548.9	548.946	46
P180	13049	549.01	549.12	110	548.822	548.865	43
P181	13060	548.82	548.93	110	548.844	548.882	38
P182	13080	548.84	548.96	120	548.808	548.842	34
Shinde	13089	548.81	548.91	100	548.804	548.834	30
P183	13102.5	548.74	548.85	110	548.755	548.785	30
P184	13129	548.63	548.74	110	548.751	548.777	26
P185	13140	548.52	548.63	110	548.778	548.798	20
P186	13170	548.54	548.63	90	548.762	548.779	17
P186a	13200	548.53	548.61	80	548.756	548.77	14
Causeway	13210	548.6	548.67	70	548.722	548.735	13
P187	13230	548.62	548.68	60	548.693	548.707	14
P188	13240	548.3	548.35	50	548.636	548.647	11
P189	13260	548.53	548.55	20	548.675	548.682	7
P190	13290	548.48	548.49	10	548.67	548.673	3
P191	13346.1	548.33	548.34	10	548.665	548.666	1
Tilak					548.56	548.56	0

Shivaji	13620	548.34	548.34	0	548.076	548.076	0
Dengle/ Kumbharwada new	13980	547.91	547.91	0	547.598	547.598	0
Wellesely	14490	547.07	547.07	0	547.19	547.19	0
Railway	14520	547.02	547.02	0	547.054	547.054	0
Sangam/RTO	14640	546.86	546.86	0	546.956	546.956	0

Table 6: Water Surface Elevations and comparison of afflux for the discharge of 60,000 ft^3/s

Brigdes and Peir Names	Chainage from Khadakwasla Dam	old survey			New (aerial) survey		
		W.S. Elev Before introduction of Metro Pier	W.S. Elev After introduction of Metro Pier	Afflux	W.S. Elev Before introduction of Metro Pier	W.S. Elev After introduction of Metro Pier	Afflux
	(m)	(m)	(m)	(mm)	(m)	(m)	(mm)
Nanded shivne bridge	3300	558.18	558.18	0	558.278	558.278	0
NH4 1	6270	553.35	553.35	0	553.33	553.331	1
Rajaram	9240	550.7	550.75	50	550.764	550.778	14
Mhatre	10860	549.19	549.31	120	548.548	548.615	67
SM Joshi	11590	548.48	548.71	230	547.791	547.947	156
YB Chavan	11790	548.41	548.67	260	547.677	547.849	172
P152	11940	548.31	548.58	270	547.504	547.697	193
P153	11970	548.29	548.58	290	547.434	547.635	201
P154	12000	548.33	548.55	220	547.407	547.609	202
P155	12020	548.12	548.36	240	547.405	547.603	198
Sambhaji/ Lakadi	12030	548.11	548.35	240	547.319	547.529	210
P156	12060	548.08	548.32	240	547.287	547.5	213
P157	12100	548.06	548.31	250	547.253	547.468	215
P158	12120	548.03	548.28	250	547.254	547.464	210
P159	12150	548	548.25	250	547.256	547.462	206
P160	12180	547.98	548.23	250	547.25	547.452	202
Z bridge	12192	547.99	548.23	240	547.183	547.395	212
P161	12210	547.97	548.22	250	547.16	547.377	217
P162	12230	547.93	548.18	250	547.129	547.354	225
P163	12240	547.91	548.16	250	547.115	547.341	226
Bhide	12270	547.85	548.1	250	547.107	547.332	225
DE1	12300	547.83	548.09	260	547.031	547.272	241
DE2	12314	547.8	548.06	260	547.028	547.266	238
DE3	12327	547.78	548.04	260	547.023	547.255	232
DE4	12330	547.77	548.02	250	547.006	547.215	209
DE5	12342	547.77	548.02	250	547.008	547.214	206
DE6	12360	547.73	547.98	250	547.002	547.204	202
DE7	12390	547.74	547.99	250	547.002	547.201	199
DE8	12393.6	547.77	547.97	200	546.958	547.16	202
DE9	12420	547.66	547.87	210	546.95	547.15	200
DE10	12428.6	547.68	547.88	200	546.935	547.129	194

P164	12450	547.66	547.86	200	546.926	547.117	191
P165	12466.1	547.67	547.86	190	546.845	547.036	191
P166	12480	547.64	547.84	200	546.833	547.02	187
P167	12510	547.43	547.66	230	546.837	547.015	178
P168	12540	547.46	547.67	210	546.819	546.985	166
P169	12570	547.49	547.69	200	546.763	546.915	152
P170	12600	547.26	547.5	240	546.752	546.901	149
P171	12630	547.23	547.46	230	546.705	546.855	150
P172	12660	547.34	547.54	200	546.676	546.824	148
P173	12690	547.23	547.42	190	546.662	546.808	146
P174	12720	547.07	547.27	200	546.587	546.739	152
P175	12750	547.12	547.31	190	546.597	546.741	144
P176	12780	547.16	547.34	180	546.601	546.737	136
SP1	12810	547.15	547.32	170	546.524	546.657	133
SP2	12820	547.17	547.33	160	546.52	546.633	113
SP3	12830	547.17	547.32	150	546.507	546.617	110
SP4	12840	547.09	547.24	150	546.5	546.599	99
SP5	12870	547.05	547.21	160	546.5	546.581	81
SP6	12880	547.1	547.25	150	546.387	546.467	80
SP7	12900	547.05	547.19	140	546.371	546.448	77
SP8	12915	547.11	547.24	130	546.375	546.446	71
SP9	12930	547.1	547.23	130	546.356	546.422	66
SP10	12945	547.11	547.24	130	546.424	546.475	51
P177	12960	546.98	547.09	110	546.41	546.456	46
P178	12990	547.03	547.14	110	546.406	546.45	44
P179	13020	546.98	547.09	110	546.409	546.448	39
P180	13049	546.99	547.09	100	546.394	546.43	36
P181	13060	547	547.09	90	546.396	546.428	32
P182	13080	546.89	546.98	90	546.358	546.386	28
Shinde	13089	546.88	546.97	90	546.352	546.375	23
P183	13102.5	546.86	546.94	80	546.291	546.316	25
P184	13129	546.78	546.87	90	546.285	546.305	20
P185	13140	546.72	546.81	90	546.303	546.315	12
P186	13170	546.62	546.72	100	546.288	546.296	8
P186a	13200	546.64	546.73	90	546.281	546.286	5
Causeway	13210	546.63	546.71	80	546.2	546.205	5
P187	13230	546.68	546.74	60	546.133	546.14	7
P188	13240	546.67	546.73	60	546.104	546.111	7
P189	13260	546.28	546.35	70	546.124	546.128	4
P190	13290	546.54	546.54	0	546.138	546.14	2
P191	13346.1	546.37	546.37	0	546.131	546.131	0
Tilak					546.066	546.066	0

Shivaji	13620	546.24	546.24	0	545.984	545.984	0
Dengle/ Kumbharwada new	13980	545.74	545.74	0	545.37	545.37	0
Wellesely	14490	544.57	544.57	0	544.685	544.685	0
Railway	14520	544.56	544.56	0	544.585	544.585	0
Sangam/RTO	14640	544.33	544.33	0	544.396	544.396	0

Table :7 Flood inundation extent for the discharge of 1,00,000 ft^3/s

Name of Bridge	W.S. Elev After introduction of Metro Pier	W.S. Elev Before introduction of Metro Pier	Water spread
Nanded shivne bridge	462.49	462.49	0.00
NH4 1	186.43	186.29	0.14
NH4 2	185.18	185.03	0.15
Rajaram	306.00	304.95	1.05
Mhatre	159.77	158.42	1.35
SM Joshi	206.82	206.63	0.19
YB Chavan	214.08	206.82	7.26
P152	205.34	202.68	2.66
P153	180.12	180.05	0.07
P154	174.26	174.16	0.10
P155	174.26	174.16	0.10
Sambhaji/ Lakadi	161.72	161.44	0.28
P156	167.20	166.77	0.43
P157	204.24	203.97	0.27
P158	196.30	194.76	1.54
P159	285.24	263.04	22.20
P160	283.31	262.70	20.61
Z bridge	325.40	295.56	29.84
P161	340.00	330.37	9.63
P162	364.56	354.80	9.76
P163	364.38	353.79	10.59
Bhide	364.25	353.31	10.94
DE1	283.27	280.68	2.59
DE2	283.21	280.66	2.55
DE3	283.13	280.63	2.50
DE4	213.90	211.13	2.77
DE5	256.41	250.16	6.25
DE6	256.31	250.01	6.30
DE7	254.78	249.61	5.17
DE8	252.16	249.10	3.06
DE9	252.05	249.03	3.02
DE10	264.80	261.69	3.11
P164	264.65	261.54	3.11
P165	230.42	227.18	3.24
P166	230.21	227.05	3.16
P167 checked road in right	278.39	222.63	55.76
P168	260.85	259.62	1.23
P169	223.19	218.10	5.09

P170	211.00	208.03	2.97
P171	230.95	230.48	0.47
P172	251.21	245.52	5.69
P173	250.60	245.21	5.39
P174	240.65	239.33	1.32
P175	225.95	224.23	1.72
P176	191.05	189.55	1.50
SP1	249.56	242.07	7.49
SP2	268.92	258.91	10.01
SP3	267.31	258.00	9.31
SP4	266.18	263.51	2.67
SP5	265.88	263.39	2.49
SP6	261.90	257.24	4.66
SP7	261.59	255.58	6.01
SP8	258.62	254.65	3.97
SP9	257.78	254.28	3.50
SP10	249.73	249.70	0.03
P177	249.73	249.70	0.03
P178	248.82	248.39	0.43
P179	243.08	242.56	0.52
P180	168.39	168.38	0.01
P181	183.53	183.51	0.02
P182	174.06	174.04	0.02
Shinde	174.06	174.04	0.02
P183	172.40	172.36	0.04
P184	172.39	172.36	0.03
P185	211.42	210.62	0.80
P186	184.98	184.85	0.13
P186a	184.92	184.82	0.10
Causeway	247.44	247.00	0.44
P187	246.59	246.14	0.45
P188	195.94	195.62	0.32
P189	225.04	224.87	0.17
P190	198.59	198.37	0.22
P191	175.54	175.53	0.01
Tilak	203.36	203.36	0.00
Shivaji	209.62	209.62	0.00
Dengle/ Kumbharwada new	164.18	164.18	0.00
Dengle/ Kumbharwada old	149.96	149.96	0.00
Wellesely	196.25	196.25	0.00
Railway	164.63	164.63	0.00
Sangam/RTO	174.98	174.98	0.00

Table :8 Flood inundation extent for the discharge of 60,000 ft^3/s

Bridge	W.S. Elev After introduction of Metro Pier	W.S. Elev Before introduction of Metro Pier	Water spread
Nanded shivne bridge	201.66	201.66	0.00
NH4 1	155.83	155.82	0.01
NH4 2	155.48	155.47	0.01
Rajaram	172.42	172.31	0.11
Mhatre	144.11	143.62	0.49
SM Joshi	204.90	204.76	0.14
YB Chavan	202.63	202.50	0.13
P152	190.75	189.96	0.79
P153	179.42	179.36	0.06
P154	172.19	171.49	0.70
P155	172.17	171.48	0.69
Sambhaji/ Lakadi	158.08	157.76	0.32
P156	163.14	162.99	0.15
P157	160.50	160.40	0.10
P158	162.76	161.98	0.78
P159	160.74	160.63	0.11
P160	160.74	160.63	0.11
Z bridge	164.67	164.36	0.31
P161	189.08	184.14	4.94
P162	209.98	199.57	10.41
P163	209.42	198.90	10.52
Bhide	209.00	197.56	11.44
DE1	192.63	187.43	5.20
DE2	192.46	187.36	5.10
DE3	192.19	187.27	4.92
DE4	170.58	168.38	2.20
DE5	175.23	173.16	2.07
DE6	175.13	173.10	2.03
DE7	180.25	178.73	1.52
DE8	184.39	182.12	2.27
DE9	184.29	182.03	2.26
DE10	169.12	166.41	2.71
P164	168.94	166.28	2.66
P165	174.08	173.43	0.65
P166	174.03	173.39	0.64
P167 checked road in right	169.89	169.12	0.77
P168	161.30	159.86	1.44
P169	150.13	149.41	0.72

P170	160.05	159.31	0.74
P171	158.23	157.60	0.63
P172	158.16	156.38	1.78
P173	157.93	156.23	1.70
P174	158.13	153.52	4.61
P175	157.97	156.36	1.61
P176	160.19	159.82	0.37
SP1	146.80	143.96	2.84
SP2	147.87	146.09	1.78
SP3	147.63	145.90	1.73
SP4	150.41	147.54	2.87
SP5	149.87	147.56	2.31
SP6	149.22	148.56	0.66
SP7	149.06	148.42	0.64
SP8	163.86	163.30	0.56
SP9	163.67	163.14	0.53
SP10	195.45	195.30	0.15
P177	195.39	195.26	0.13
P178	190.83	190.82	0.01
P179	183.24	183.21	0.03
P180	163.47	163.08	0.39
P181	182.45	182.44	0.01
P182	172.99	172.98	0.01
Shinde	172.98	172.97	0.01
P183	169.83	169.81	0.02
P184	169.82	169.80	0.02
P185	177.33	177.31	0.02
P186	162.95	162.94	0.01
P186a	162.94	162.94	0.00
Causeway	150.08	150.08	0.00
P187	150.02	150.02	0.00
P188	147.50	147.47	0.03
P189	165.21	165.20	0.01
P190	167.83	167.83	0.00
P191	167.42	167.42	0.00
Tilak	159.83	159.83	0.00
Shivaji	172.83	172.83	0.00
Dengle/ Kumbharwada new	157.44	157.44	0.00
Dengle/ Kumbharwada old	138.75	138.75	0.00
Wellesely	175.69	175.69	0.00
Railway	156.63	156.63	0.00
Sangam/RTO	165.41	165.41	0.00

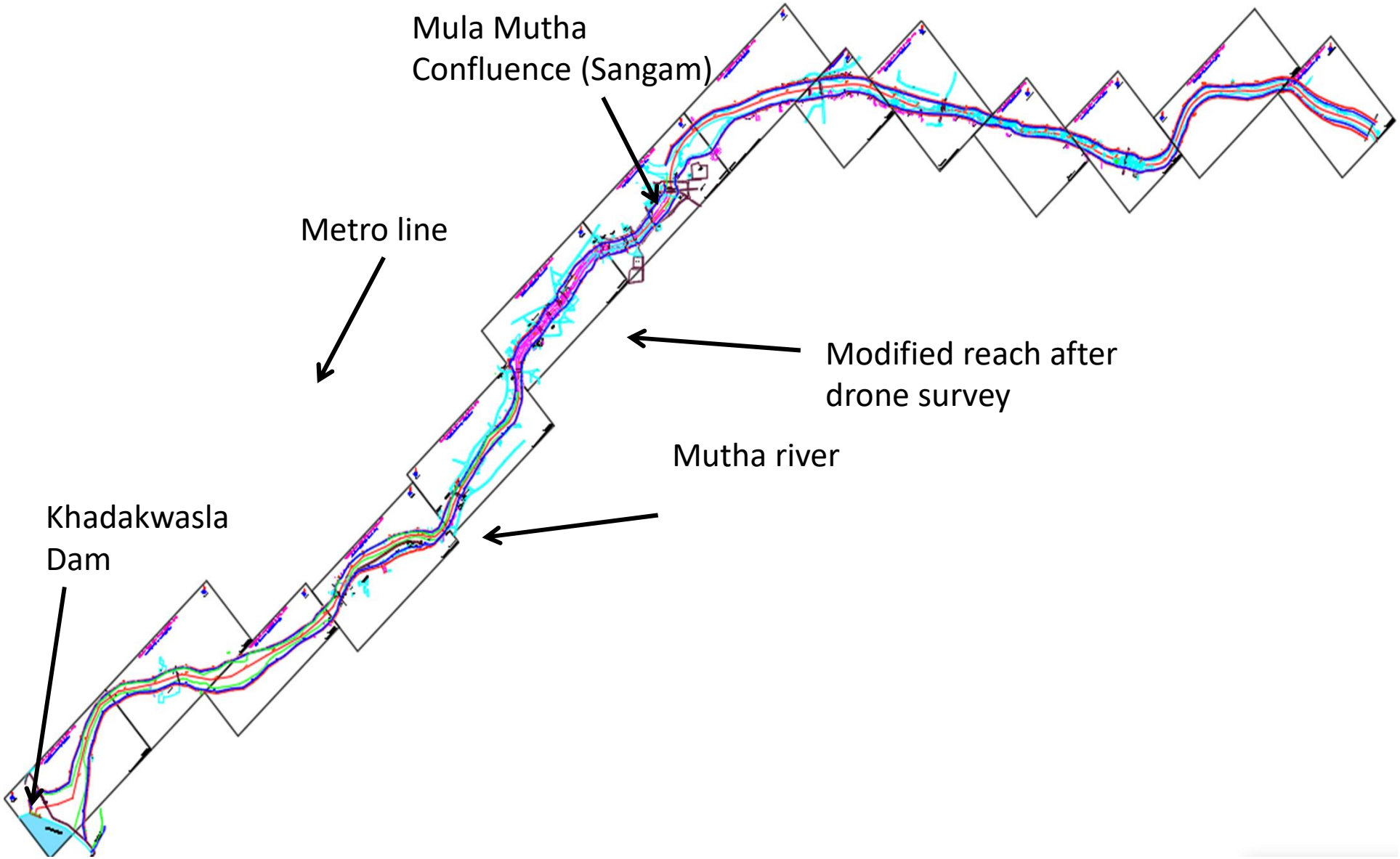


Figure 1(a): Study Reach

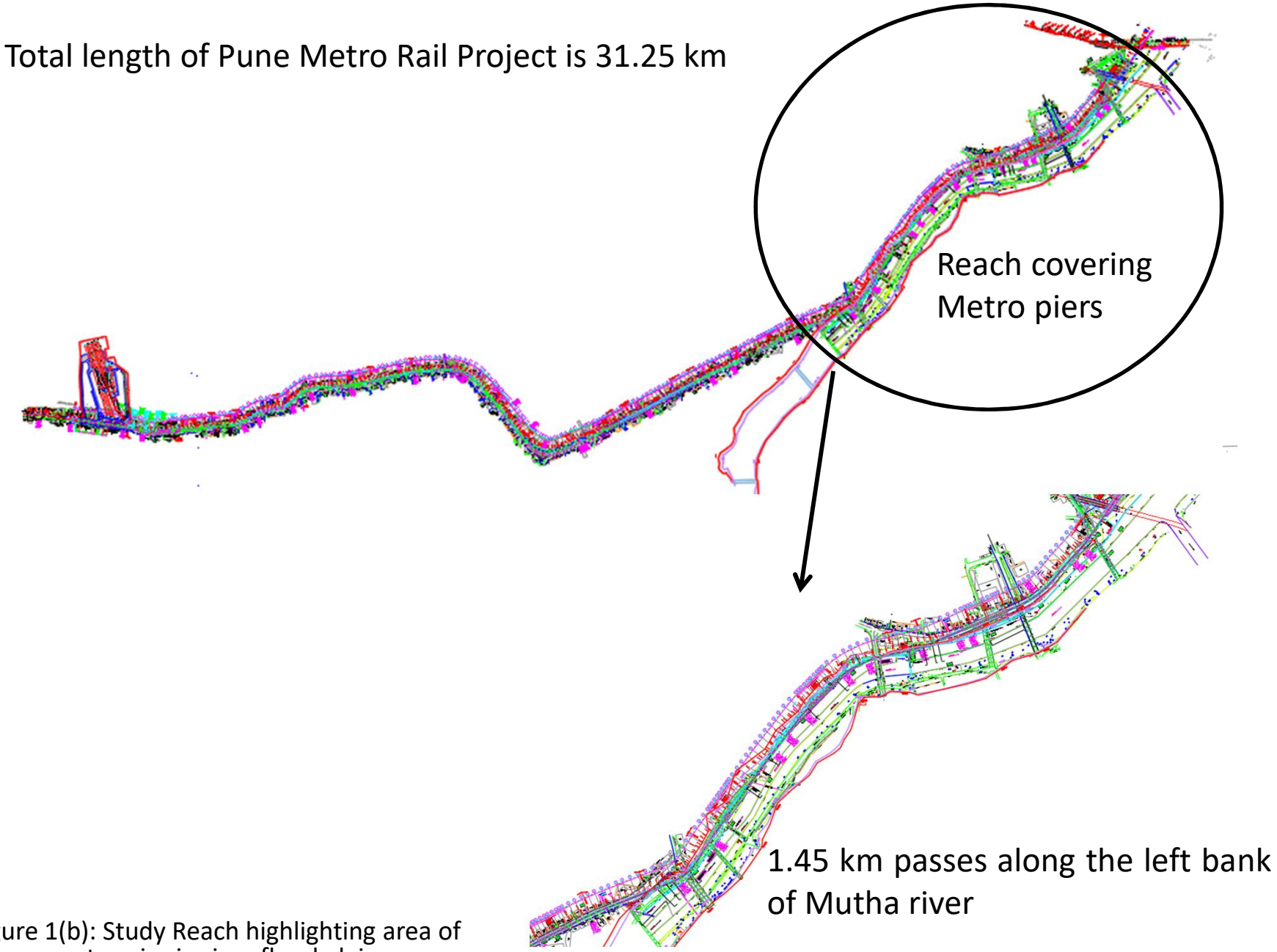


Figure 1(b): Study Reach highlighting area of metro pier in river flood plain

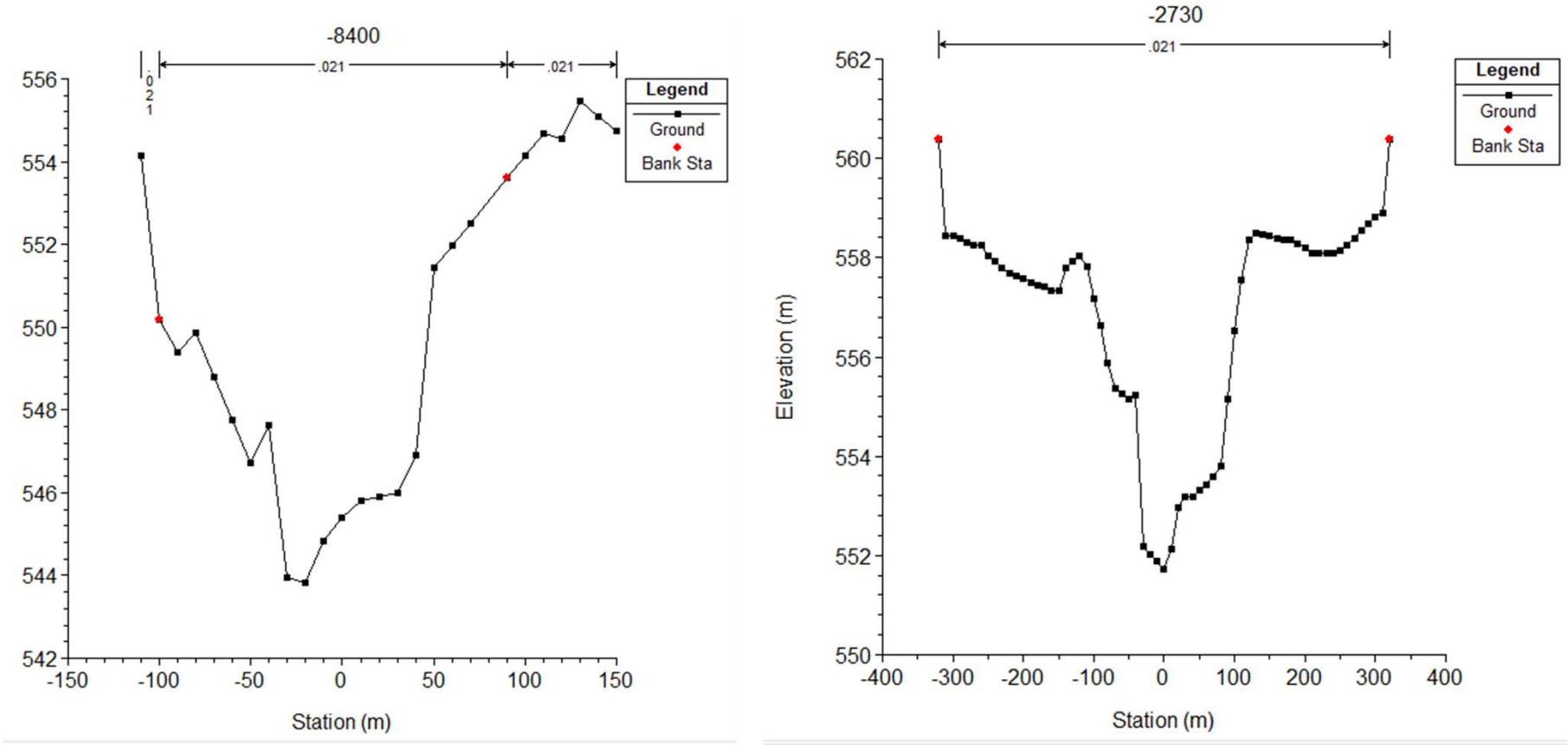


Figure 2: Representative cross sections of Mutha river in the study reach

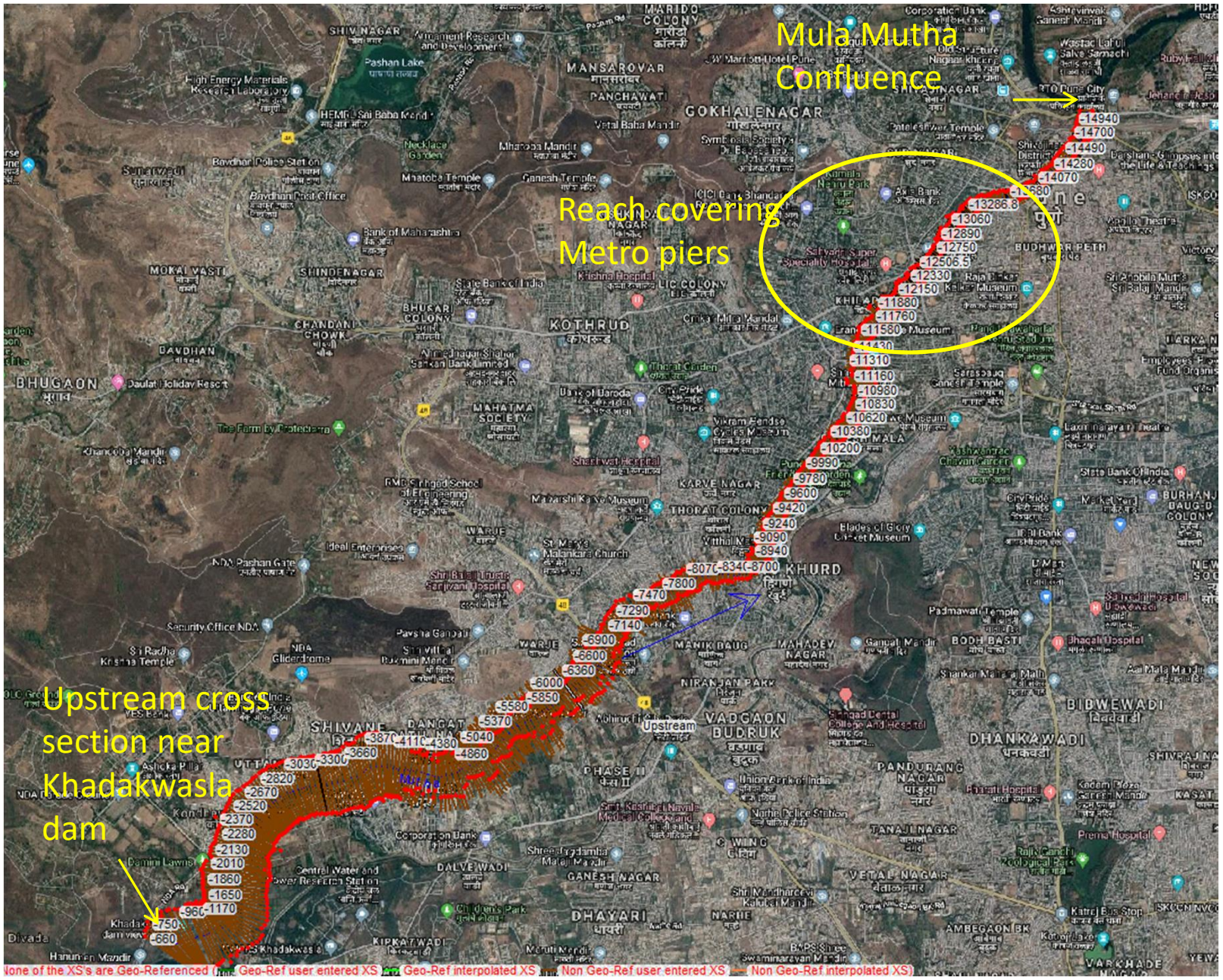


Figure 3: River schematic in HEC-RAS

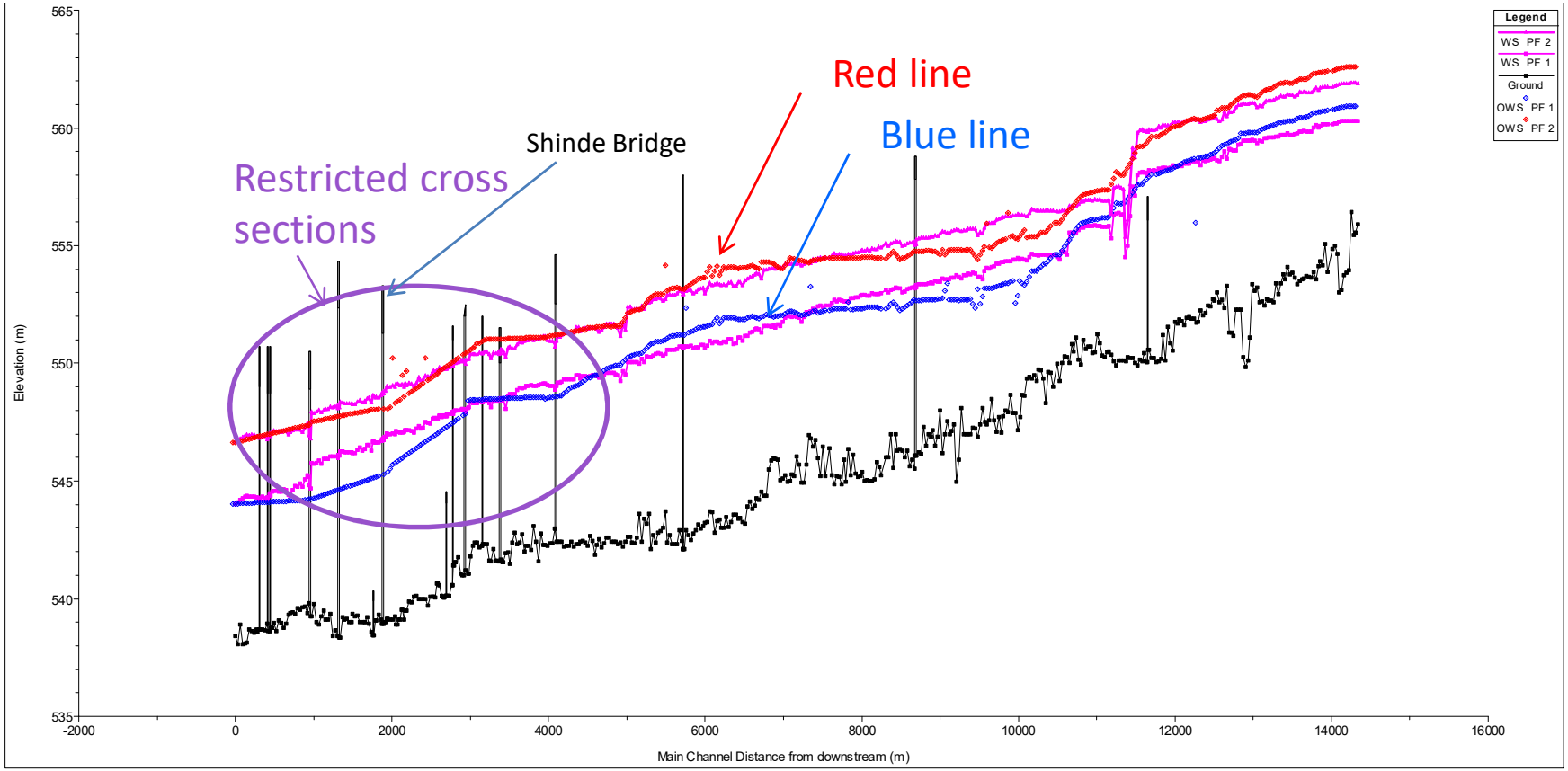


Figure 4: Water surface profiles incorporating existing bridges without metro piers alongwith blue line (60,000 ft3/s) and red line (1,00,000 ft3/s)

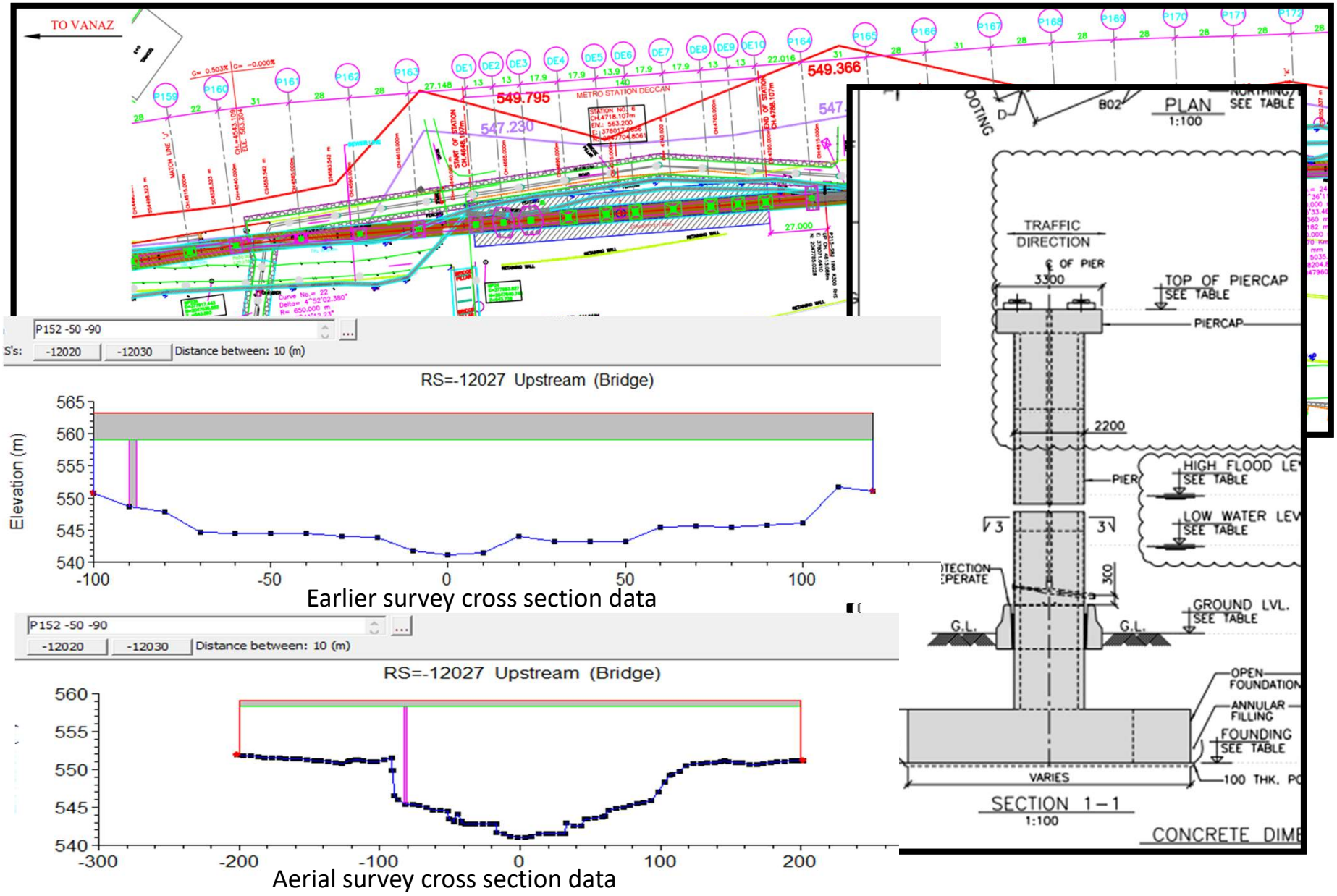
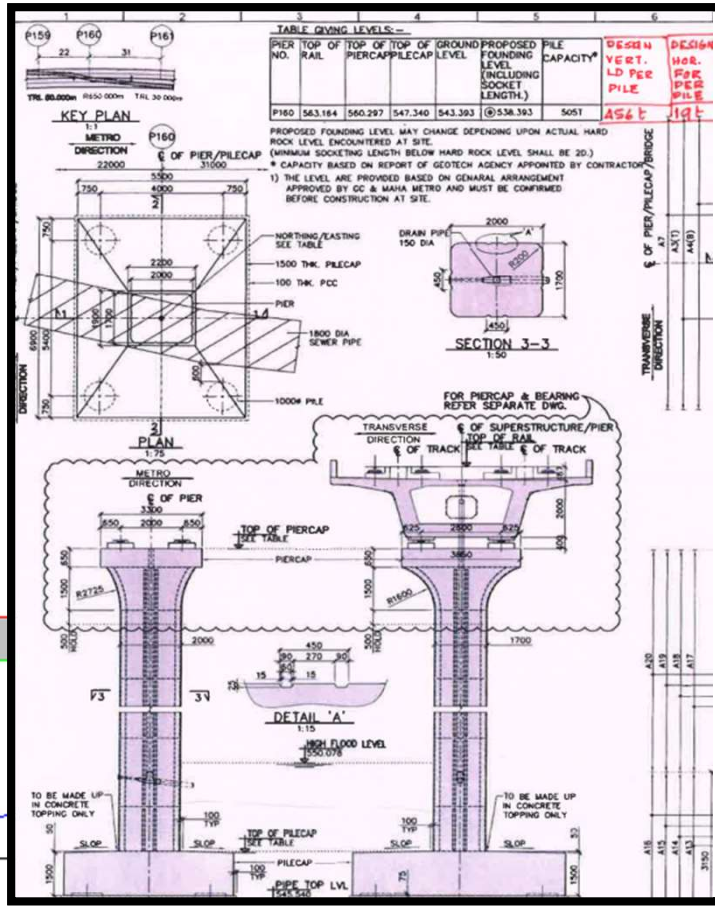
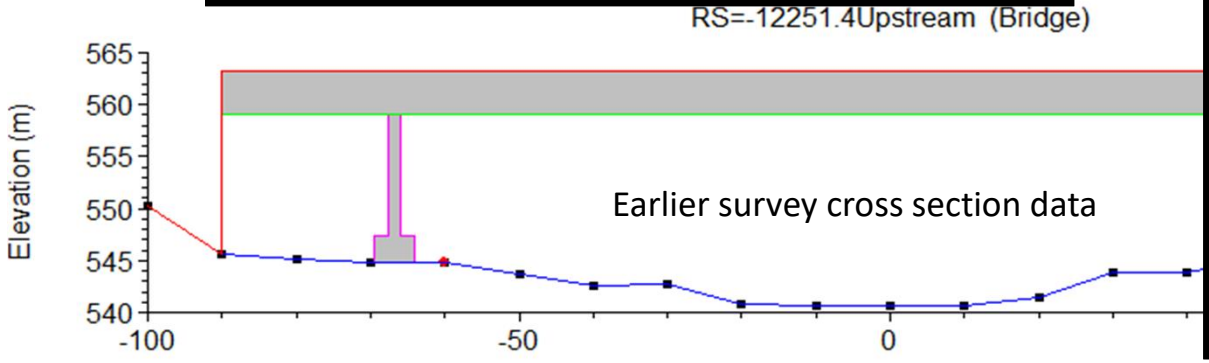


Figure 5: Sample Data Metro pier (P152) near Sambhaji Bridge





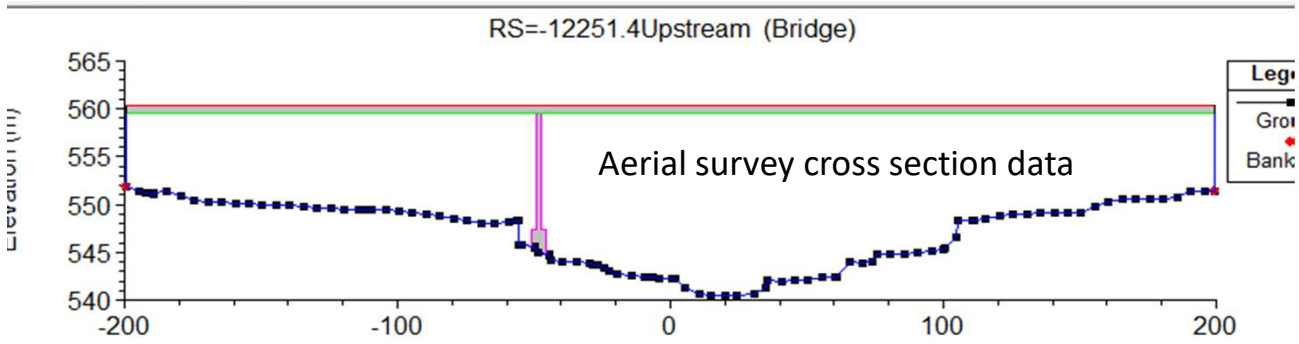


Figure 6: Sample Data Metro pier (P160) near Gadgil (Z) Bridge

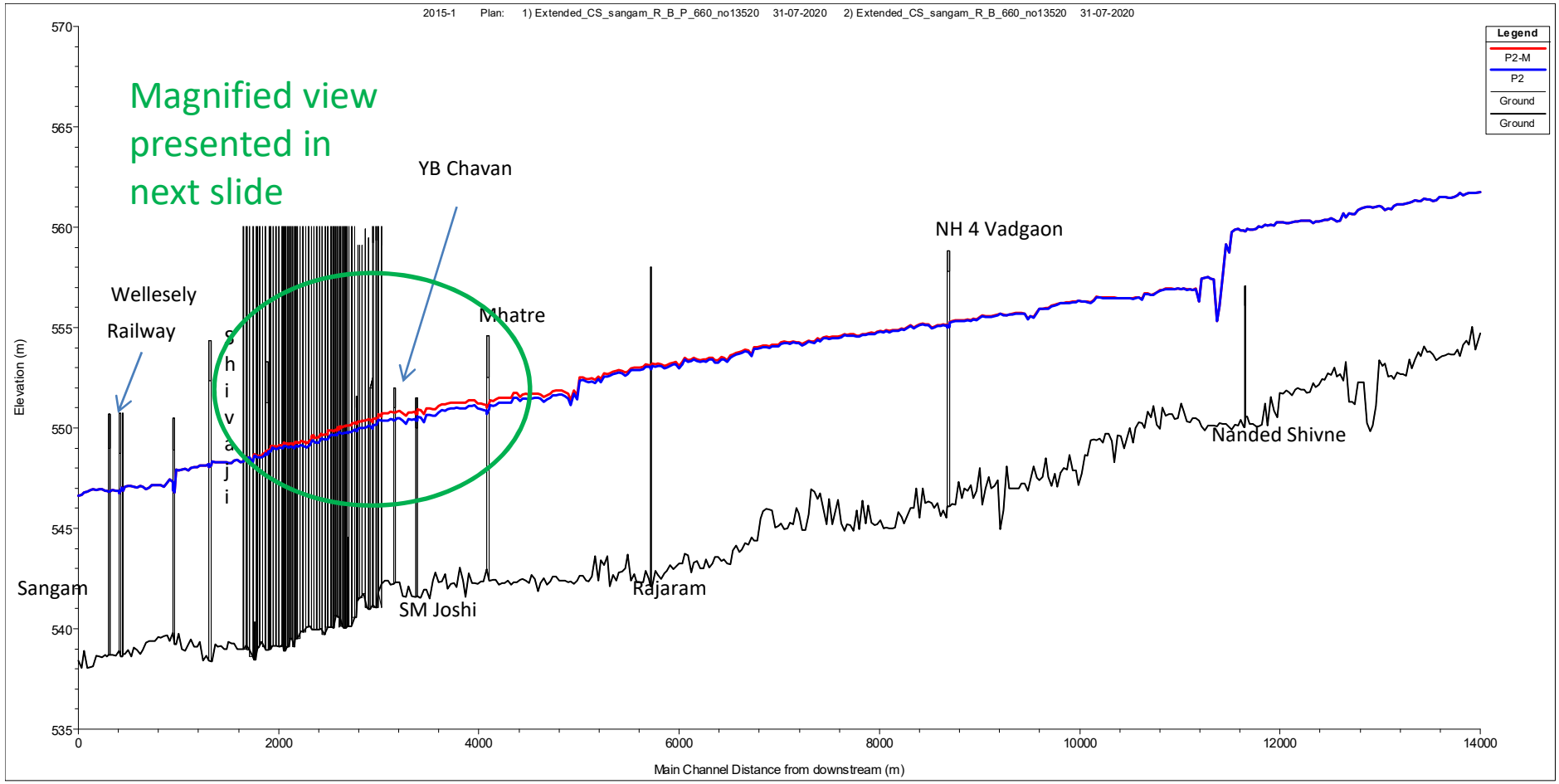


Figure 7(a): Water surface elevation for the discharge of 1,00,000 ft3/s (incorporating existing bridge and Metro piers)

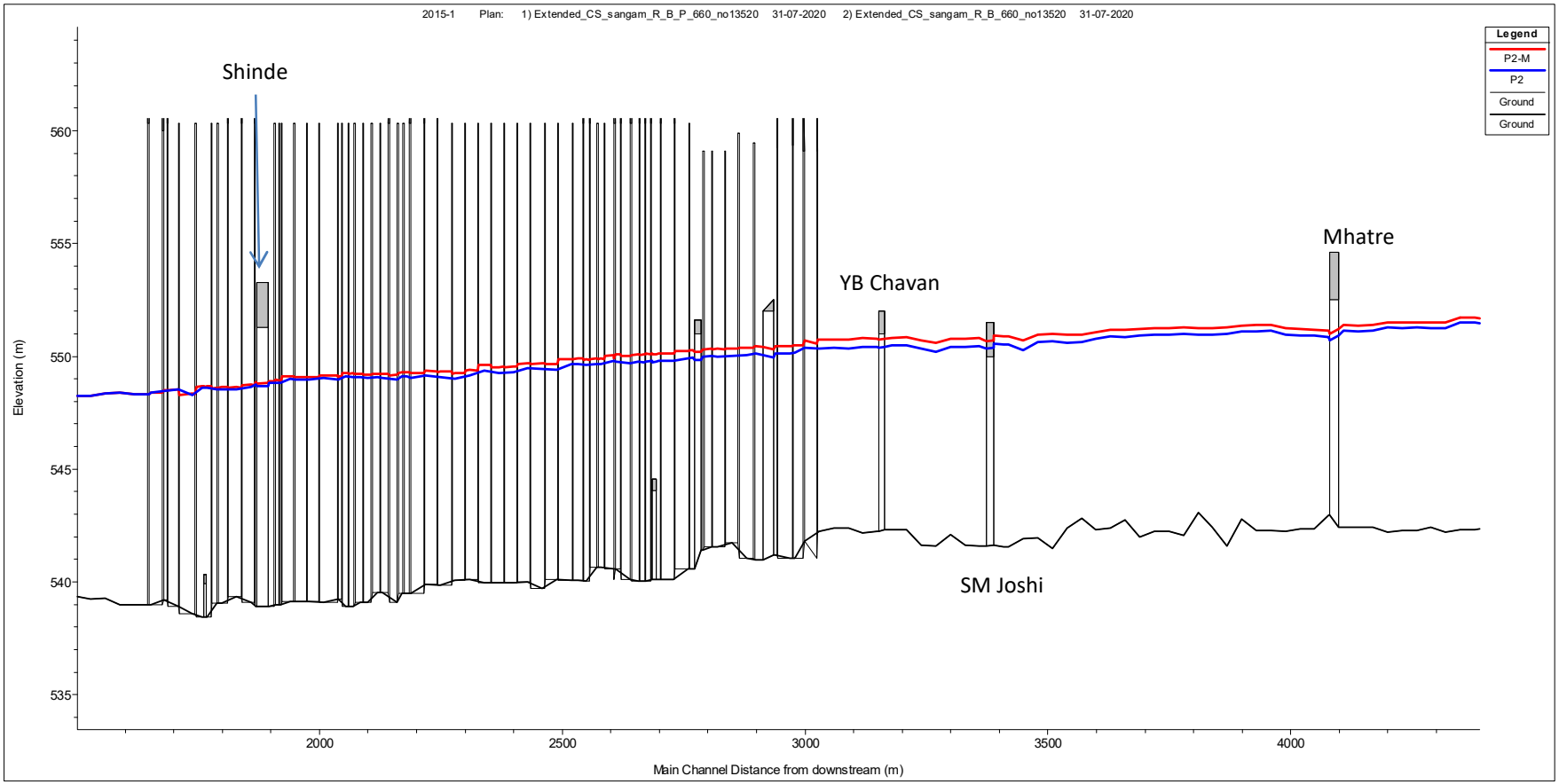


Figure 7(b) : Zoomed view of
Water Surface Elevations for the discharge of 1,00,000 ft3/s

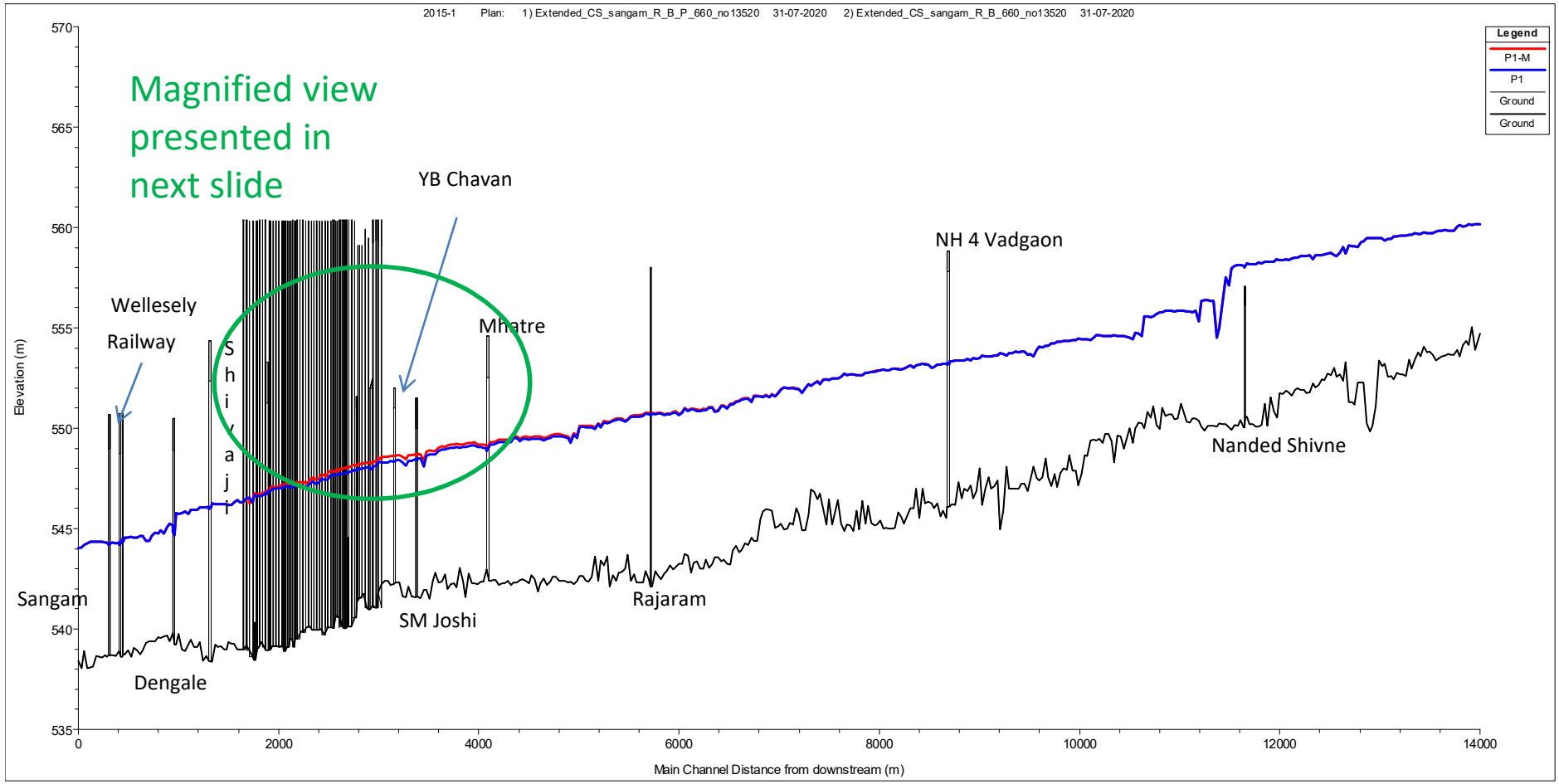


Figure 8(a): Water surface elevation for the discharge of 60,000 ft3/s (incorporating existing bridge and Metro piers)

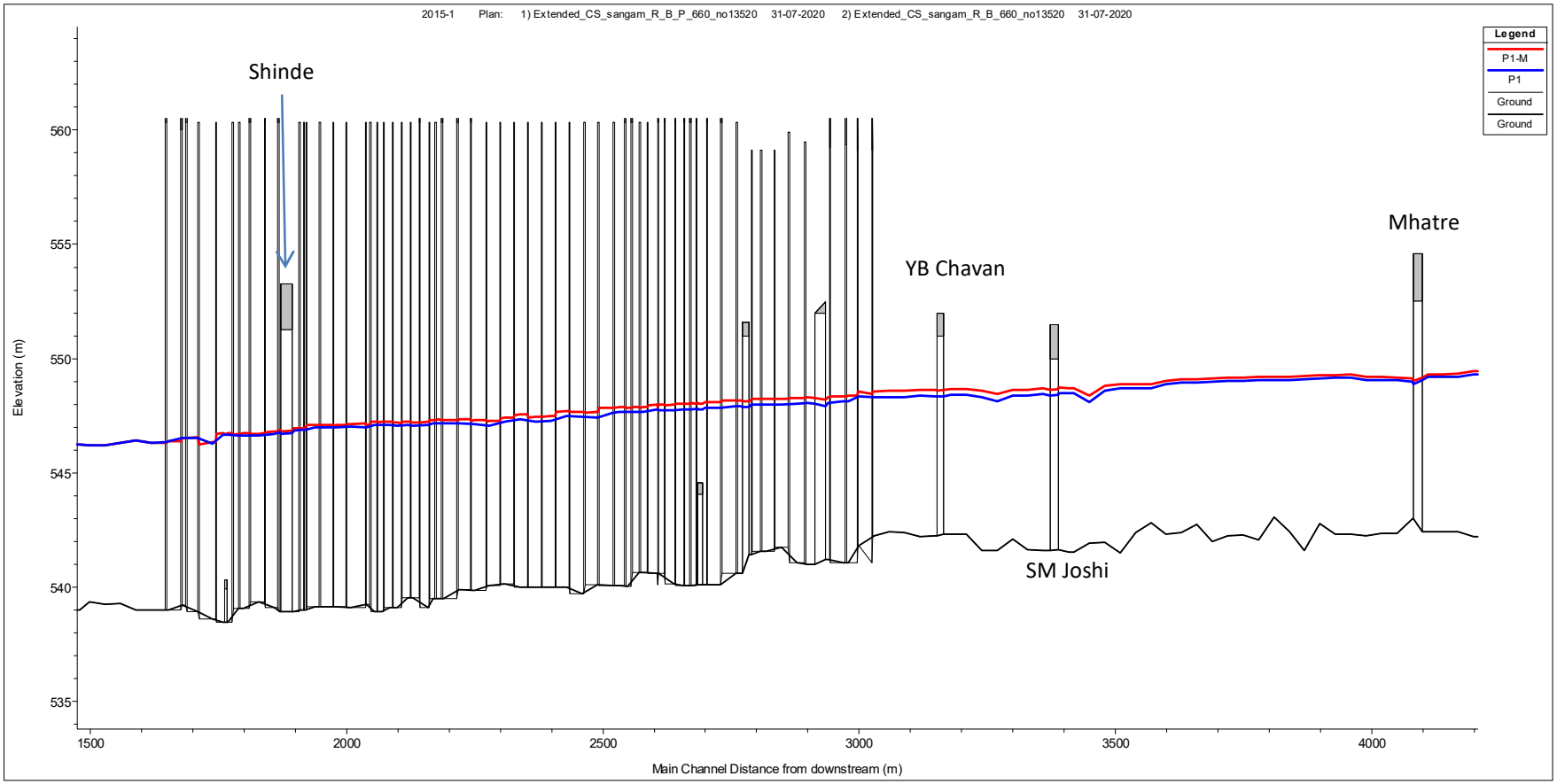
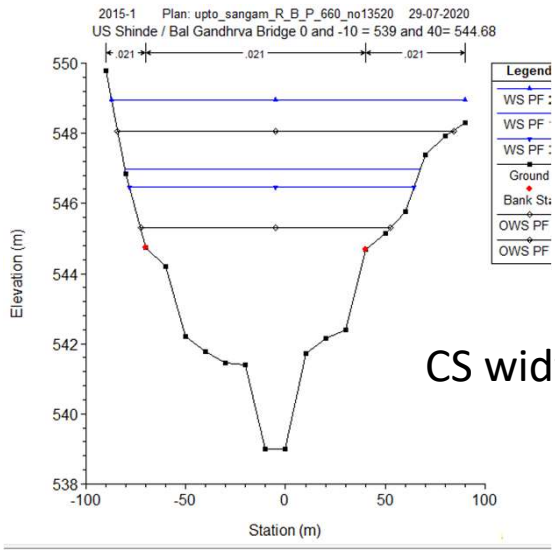
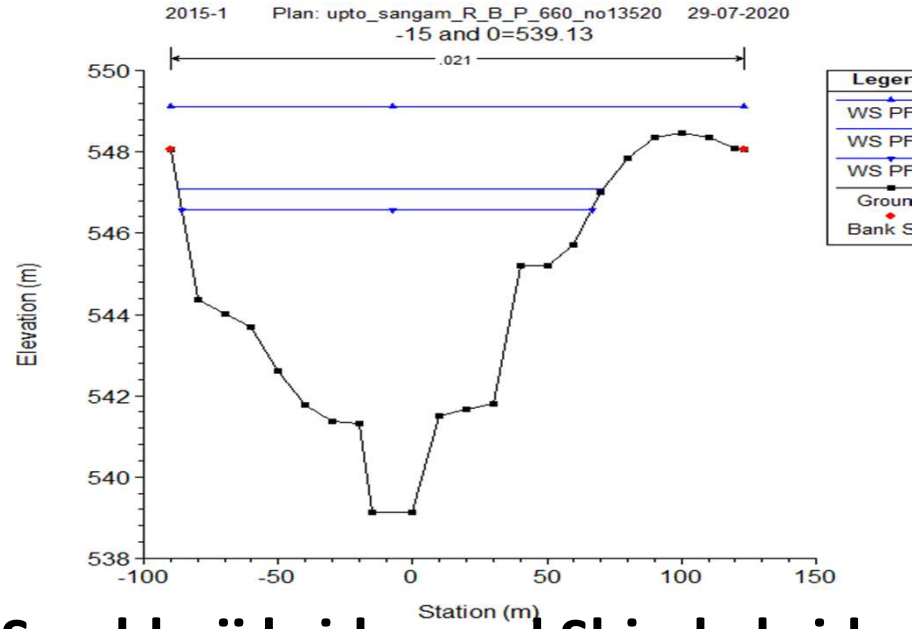


Figure 8(b) : Zoomed view of
Water Surface Elevations for the discharge of 60,000 ft3/s

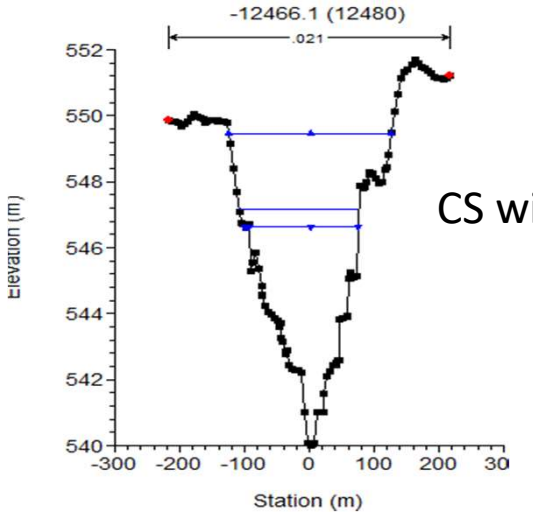
Restricted cross sections between Sambhaji bridge and Shinde bridge



CS width 200 m



Extended cross sections between Sambhaji bridge and Shinde bridge



CS width 450 m

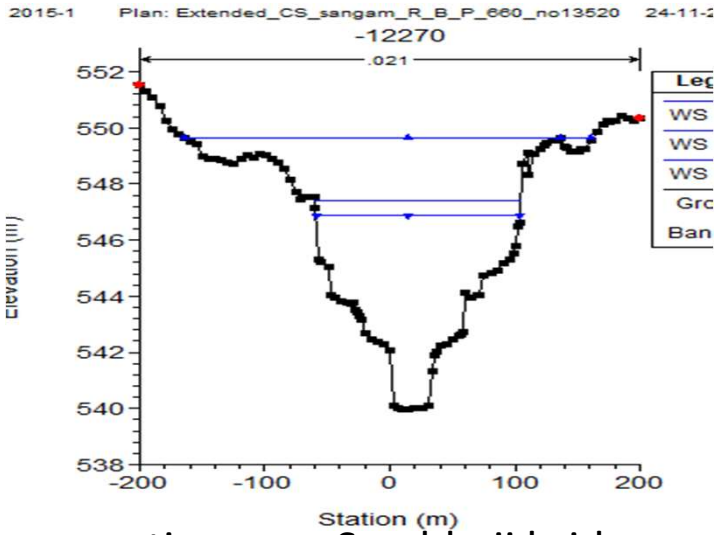


Figure 9: Restricted and extended cross section near Sambhaji bridge

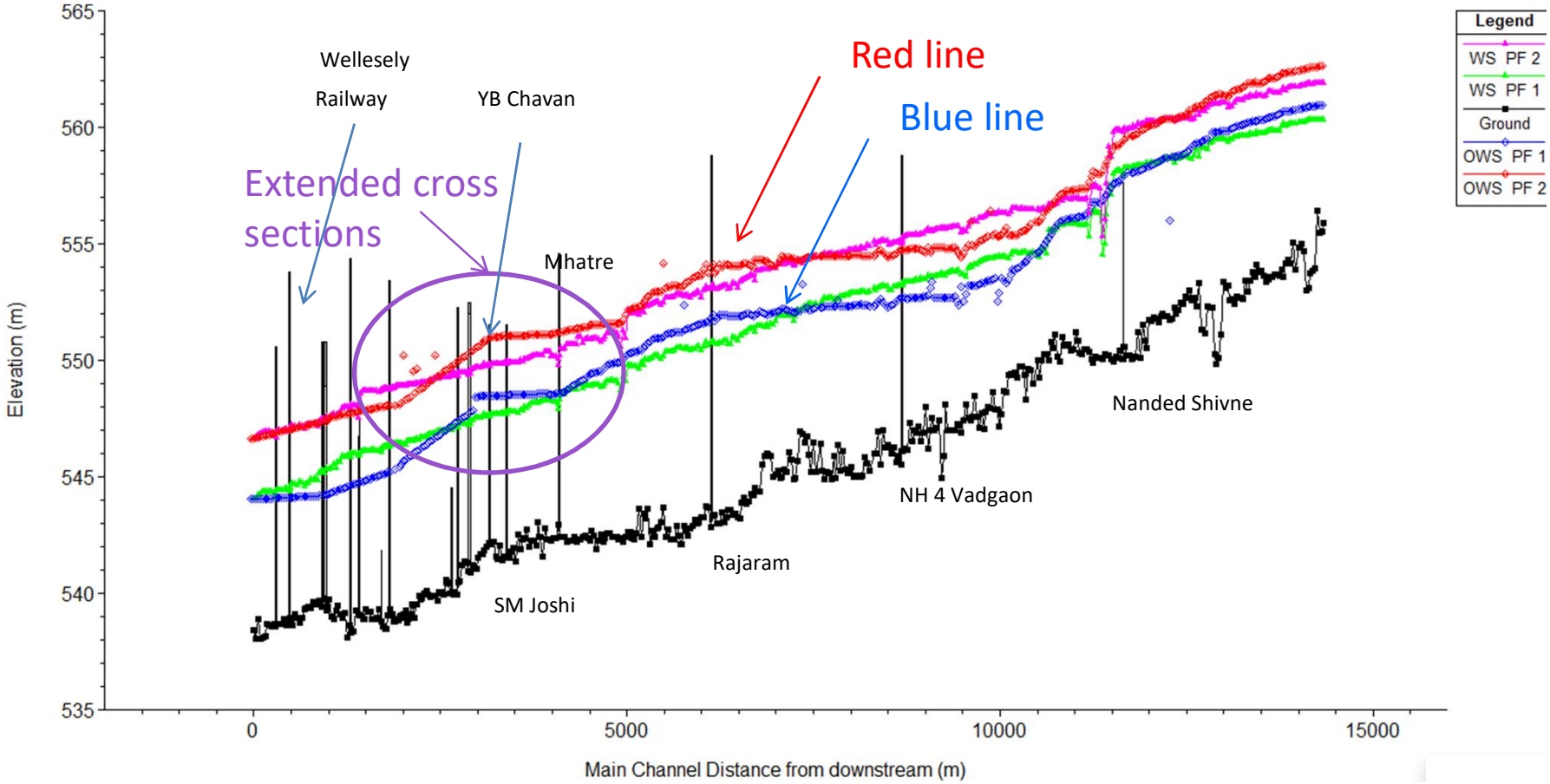


Figure 10: Water surface profiles using aerial survey data incorporating existing bridges alongwith blue line (60,000 ft3/s) and red line (1,00,000 ft3/s)

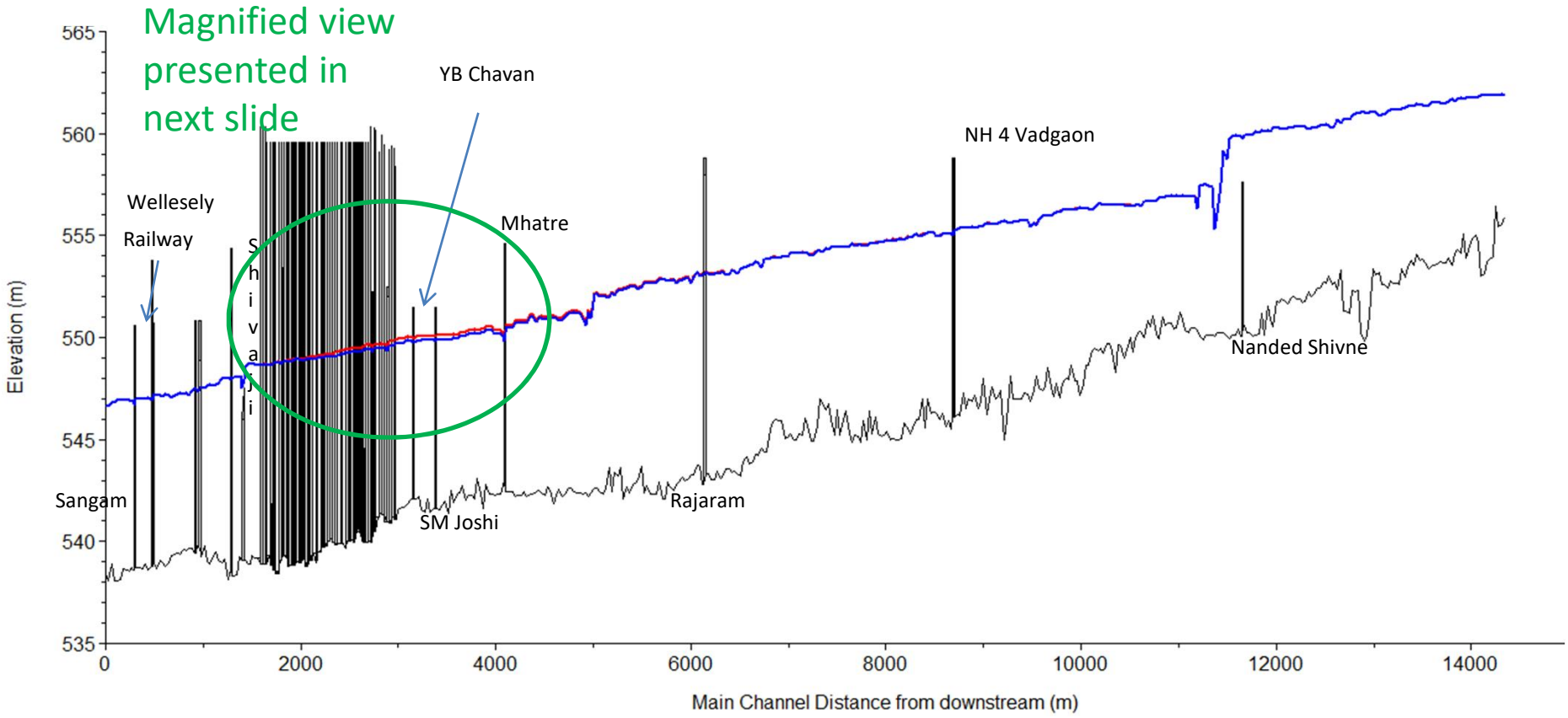


Figure 11(a): Water surface profiles using aerial survey data incorporating existing bridges and Metro piers for discharge of 1,00,000 ft3/s

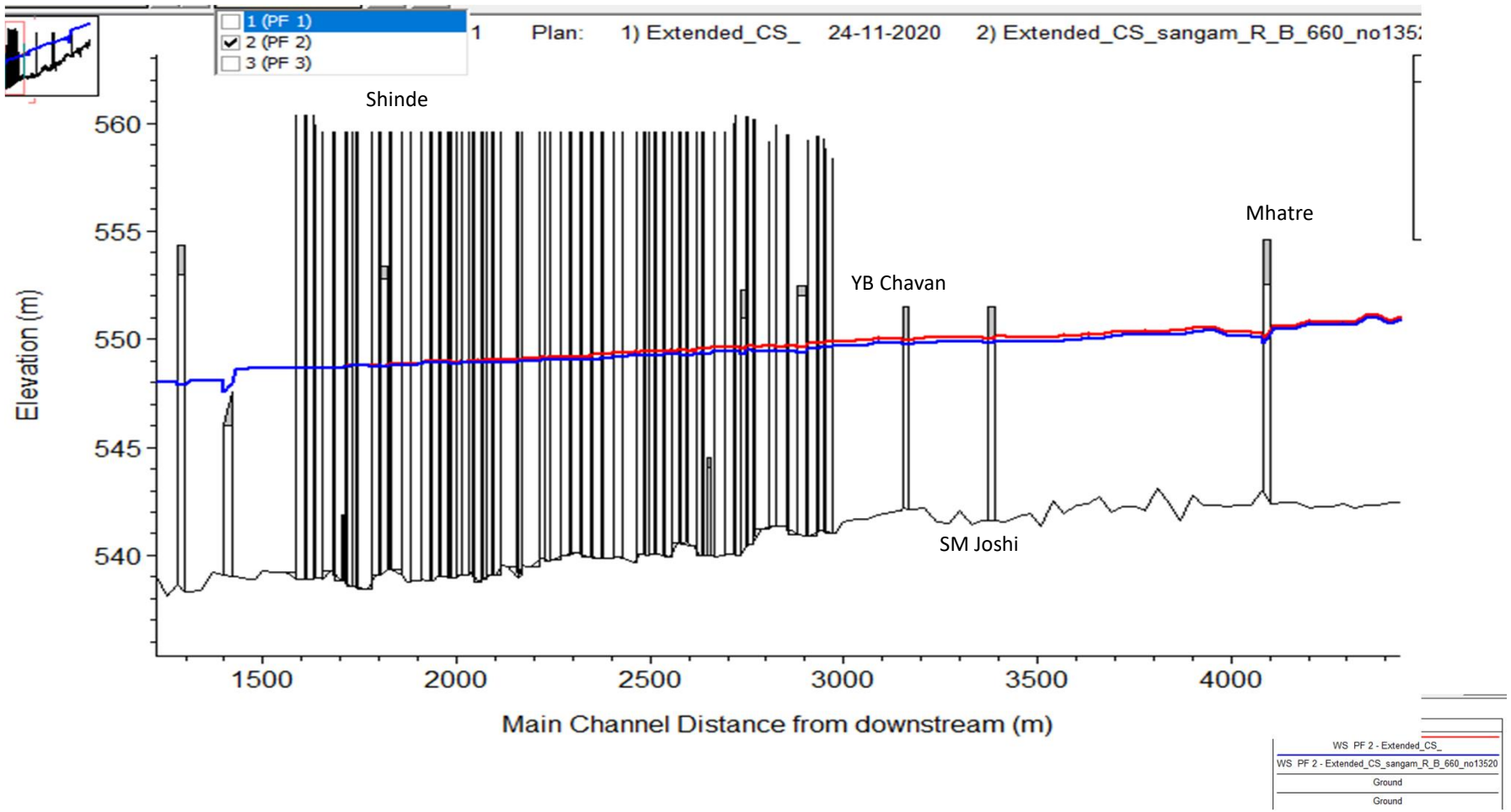


Figure 11(b): Zoomed view of water surface profiles using aerial survey data incorporating existing bridges and Metro piers for discharge of 1,00,000 ft3/s

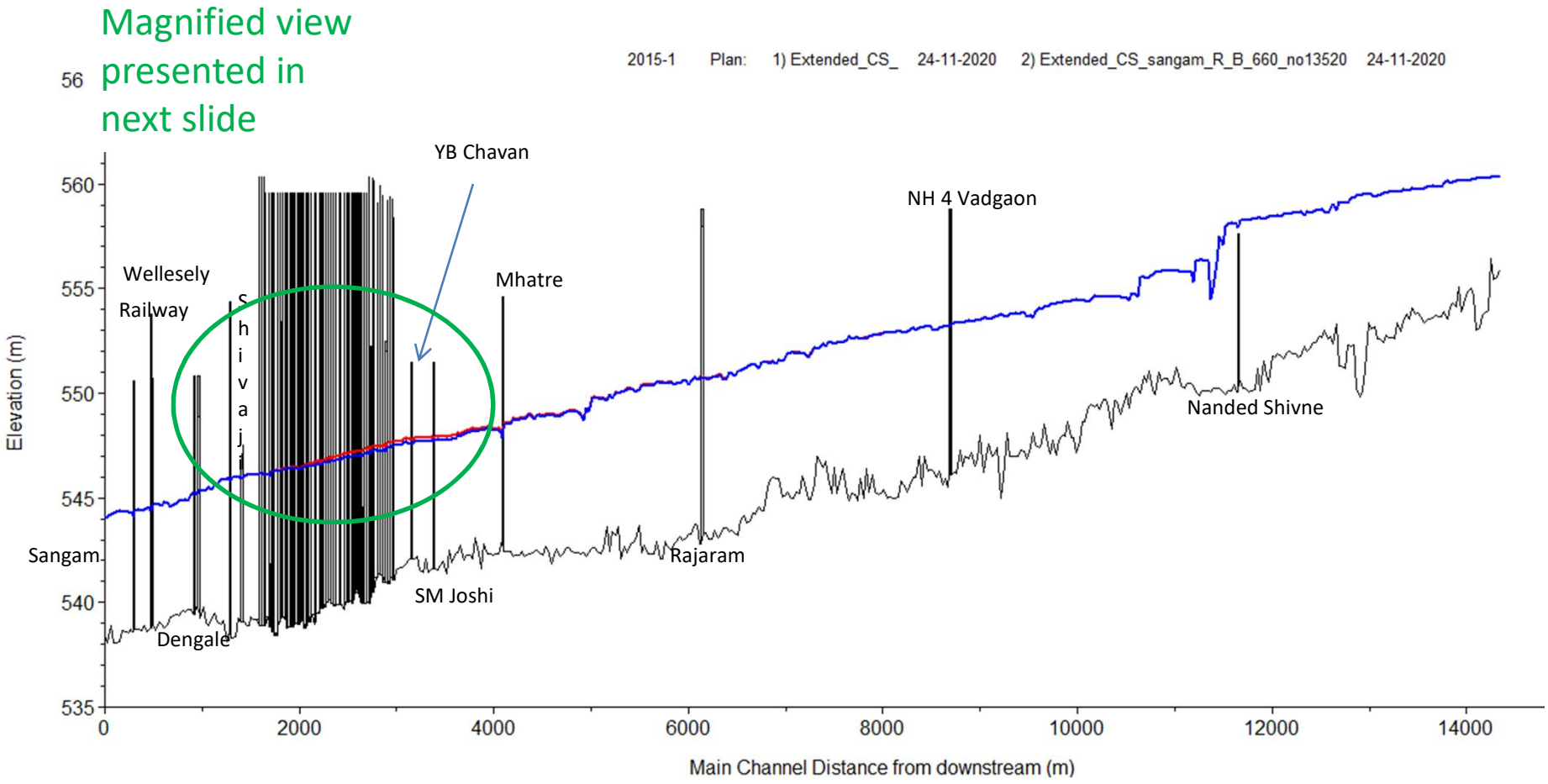


Figure 12(a): Water surface profiles using aerial survey data incorporating existing bridges and Metro piers for discharge of 60,000 ft3/s

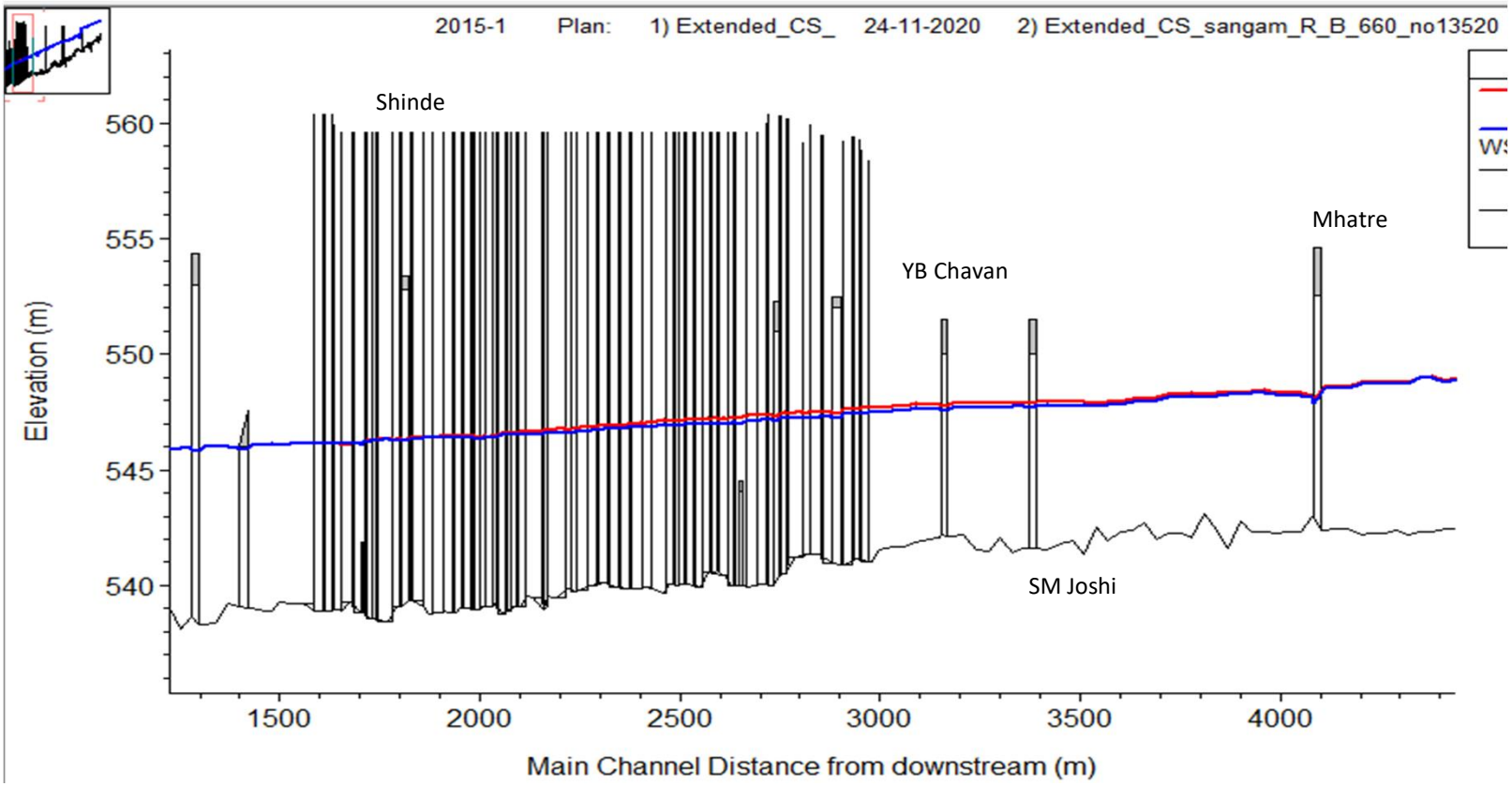


Figure 12(b): Zoomed view of water surface profiles using aerial survey data incorporating existing bridges and Metro piers for discharge of 60,000 ft3/s

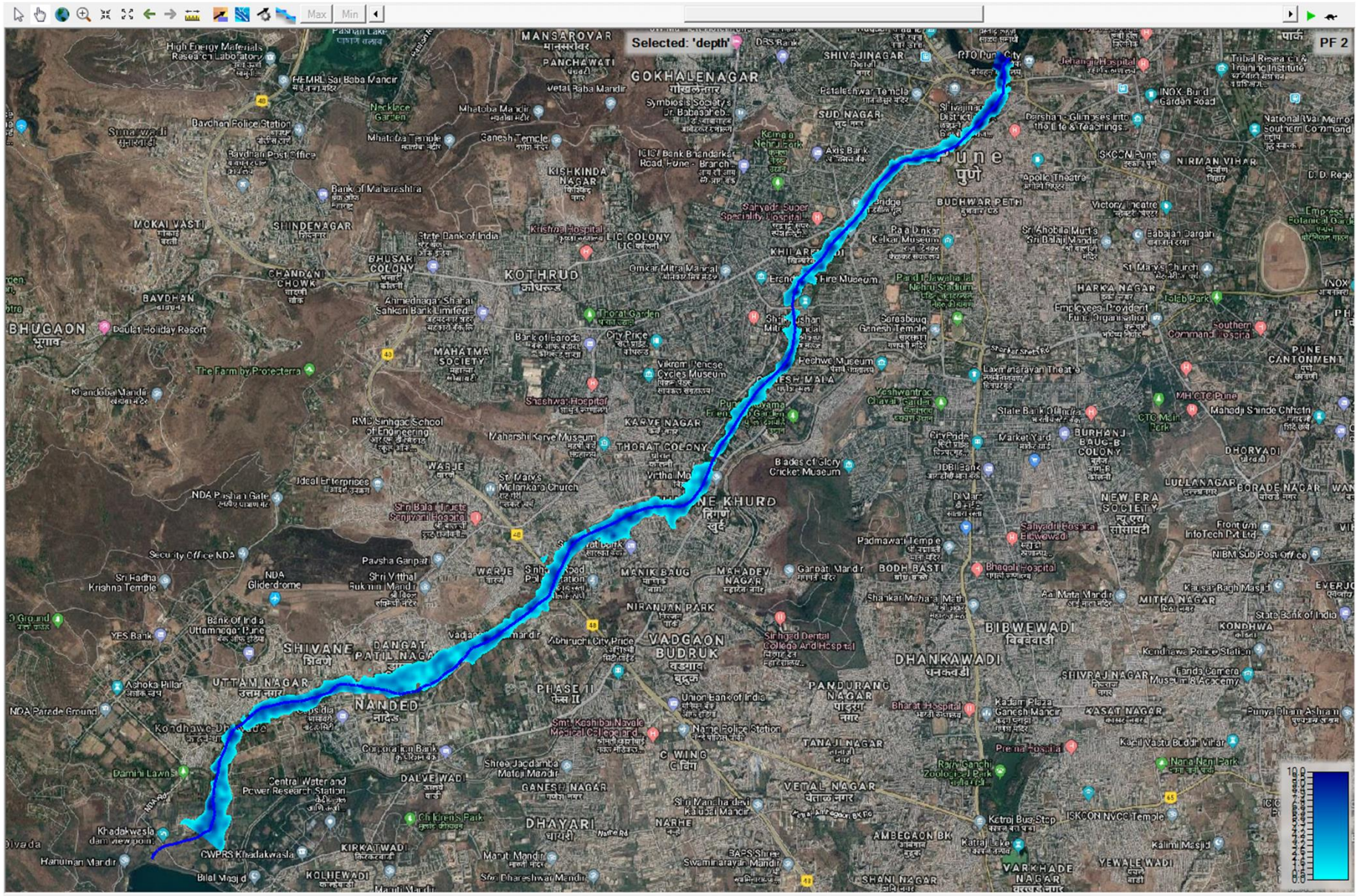


Figure 13: Flood inundation map overlaid on Google map for the discharge of 1,00,000 ft3/s covering the entire study reach

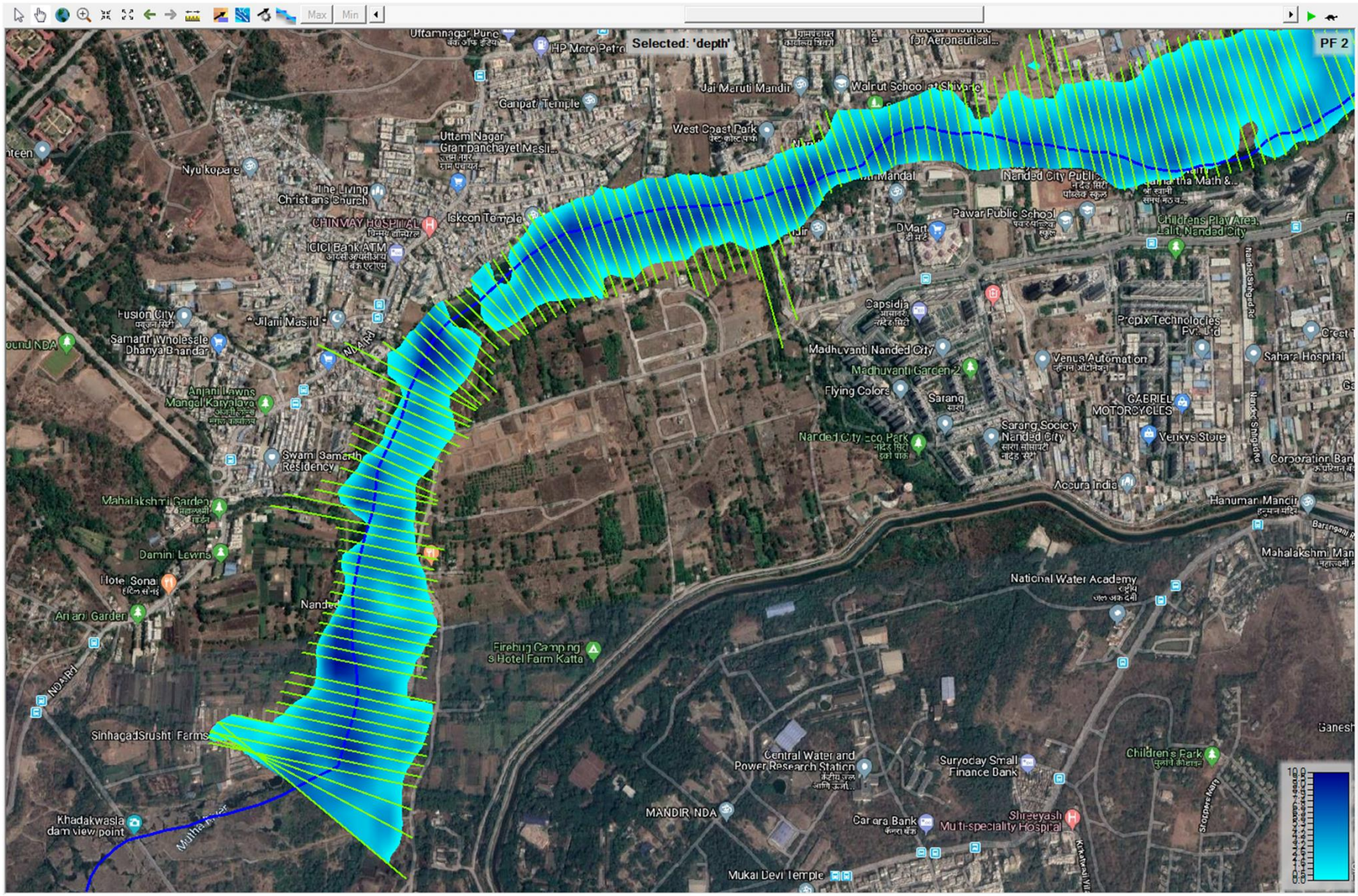


Figure 14: Flood inundation map overlaid on Google map for the discharge of 1,00,000 ft3/s covering reach from Khadakwasla dam to Nanded city

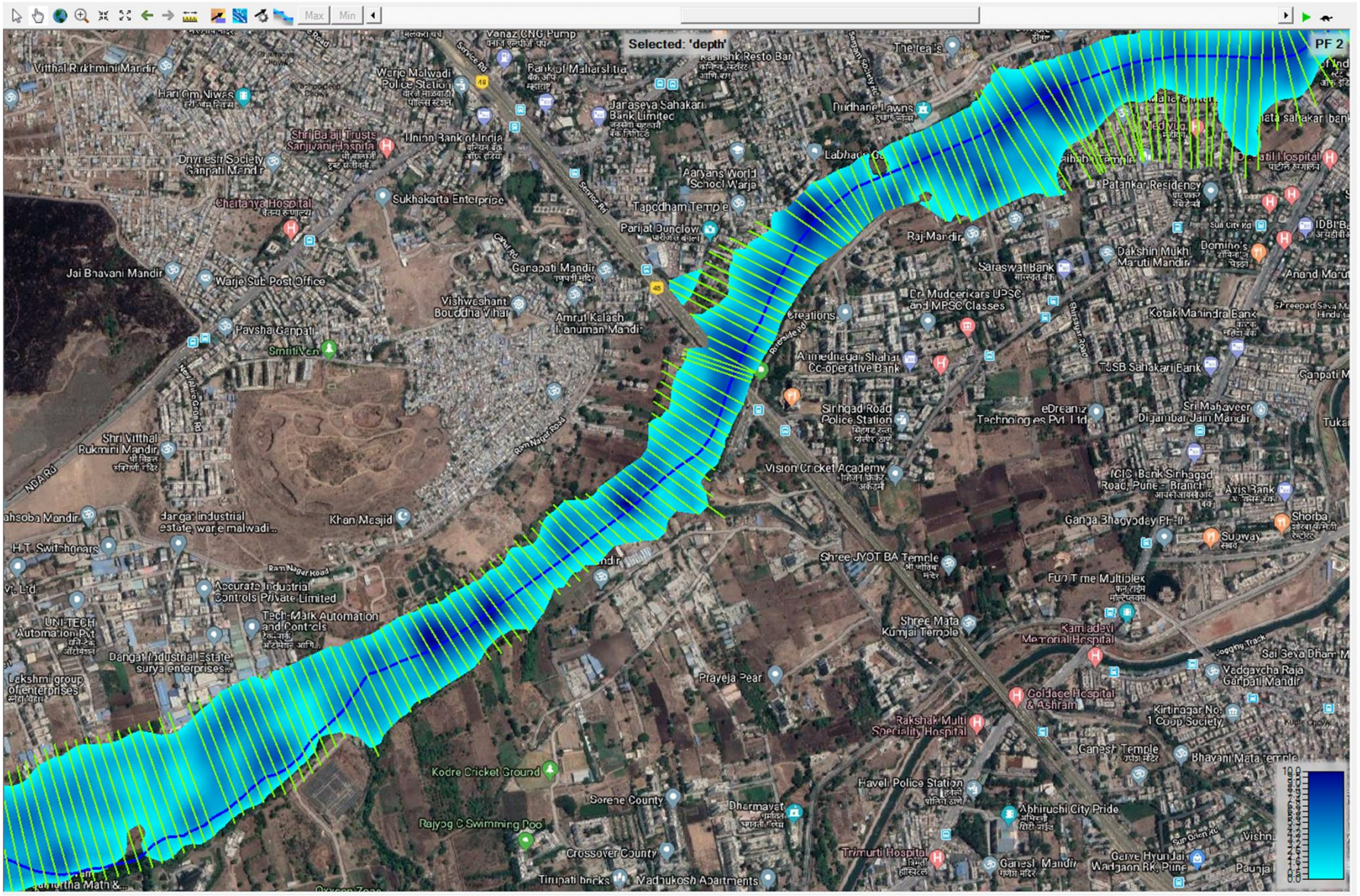


Figure 15: Flood inundation map overlaid on Google map for the discharge of 1,00,000 ft3/s covering reach from Nanded city to Anand nagar

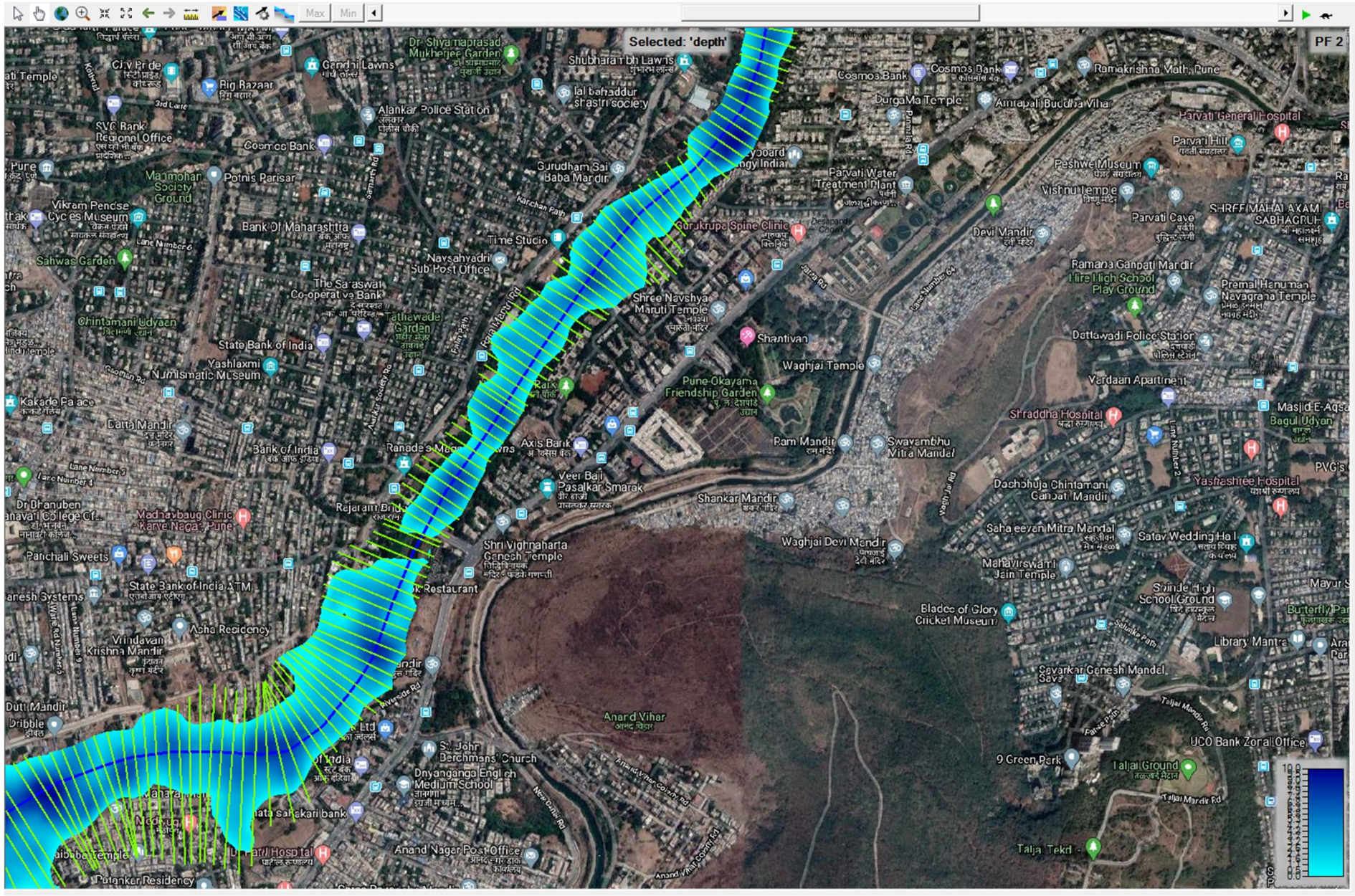


Figure 16: Flood inundation map overlaid on Google map for the discharge of 1,00,000 ft3/s covering reach from Anand nagar to Mhatre bridge

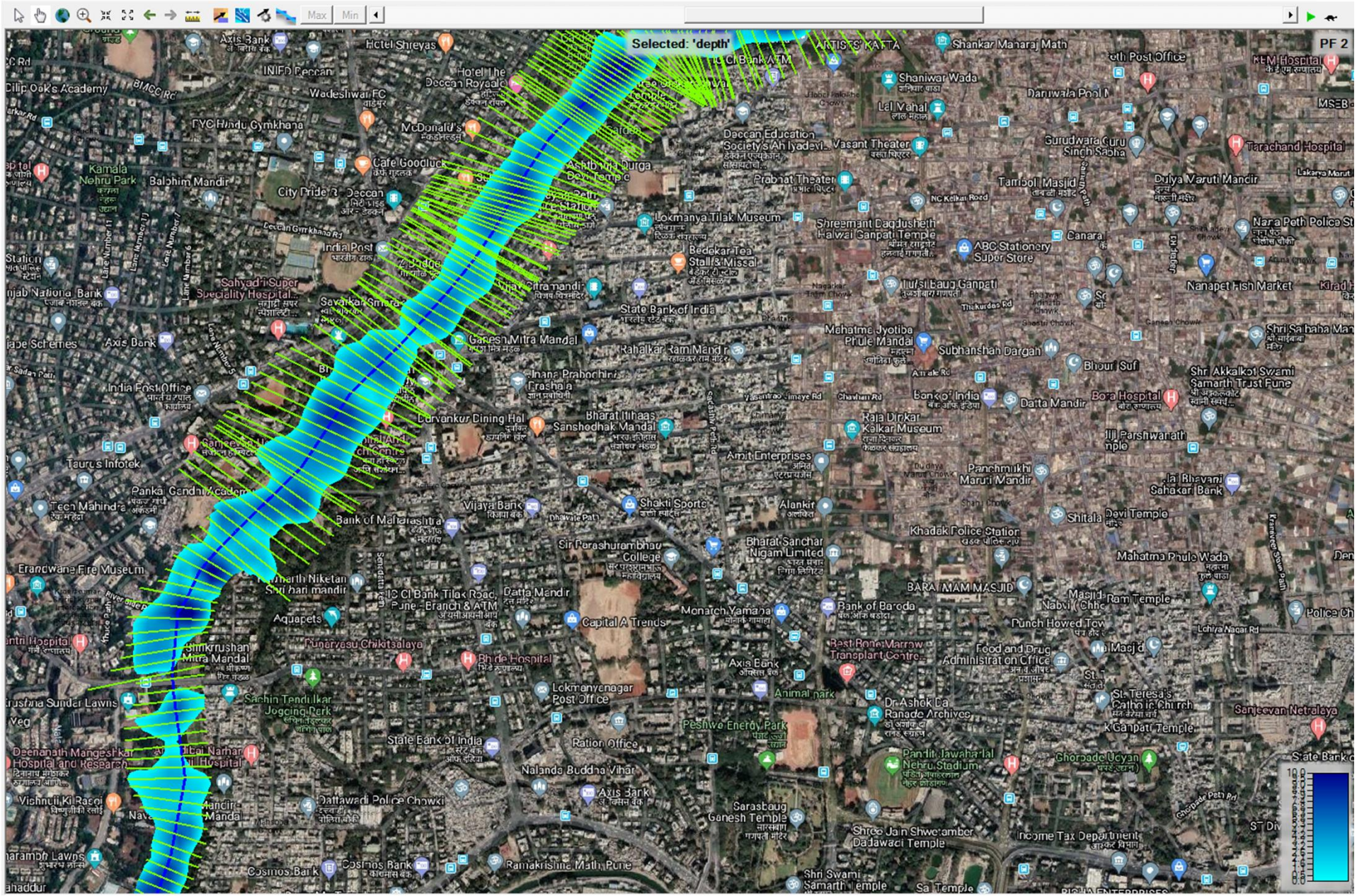


Figure 17: Flood inundation map overlaid on Google map for the discharge of 1,00,000 ft3/s covering reach from Mhatre bridge to Tilak bridge

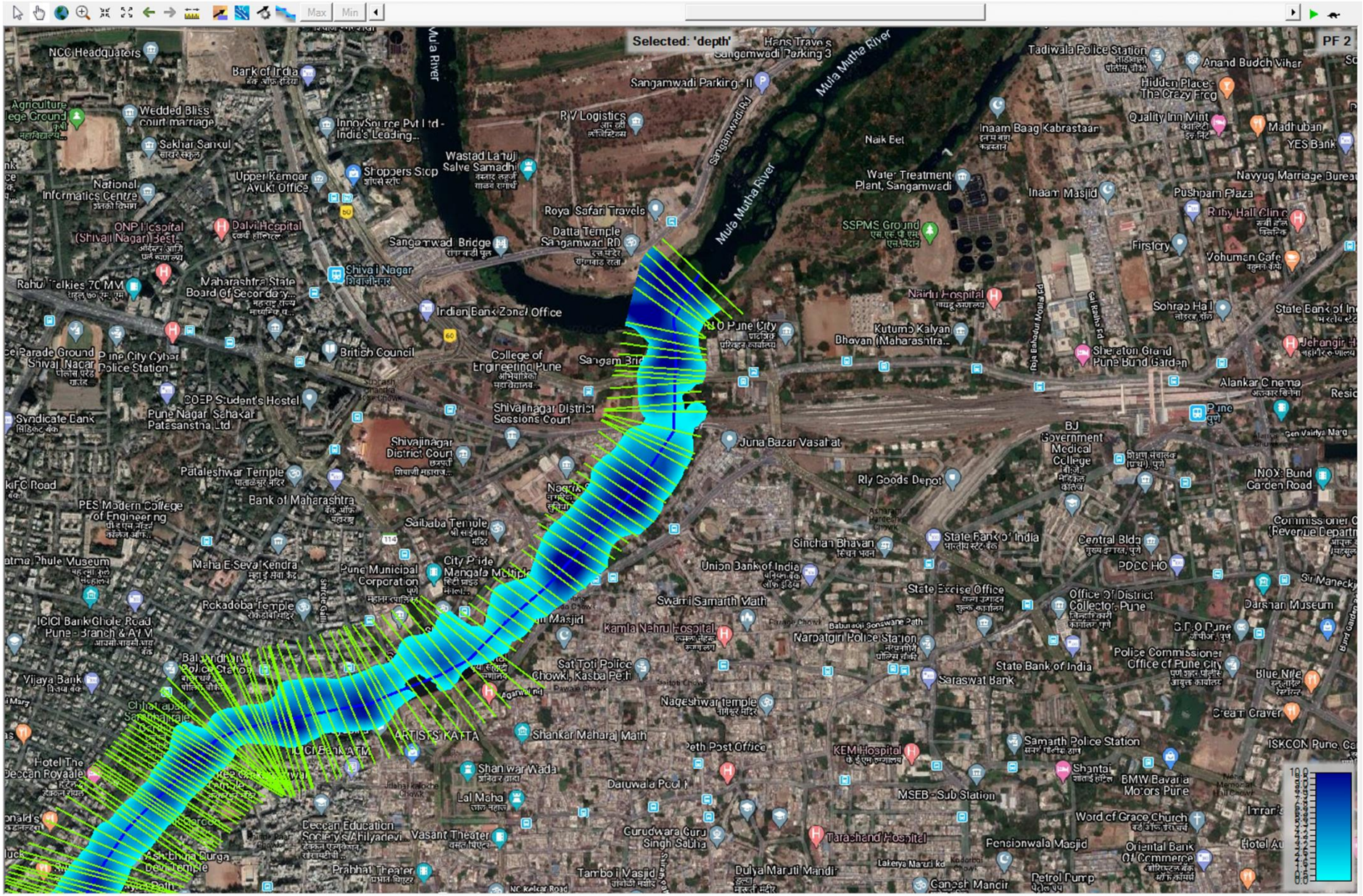


Figure 18: Flood inundation map overlaid on Google map for the discharge of 1,00,000 ft3/s covering reach from Tilak bridge to Sangam

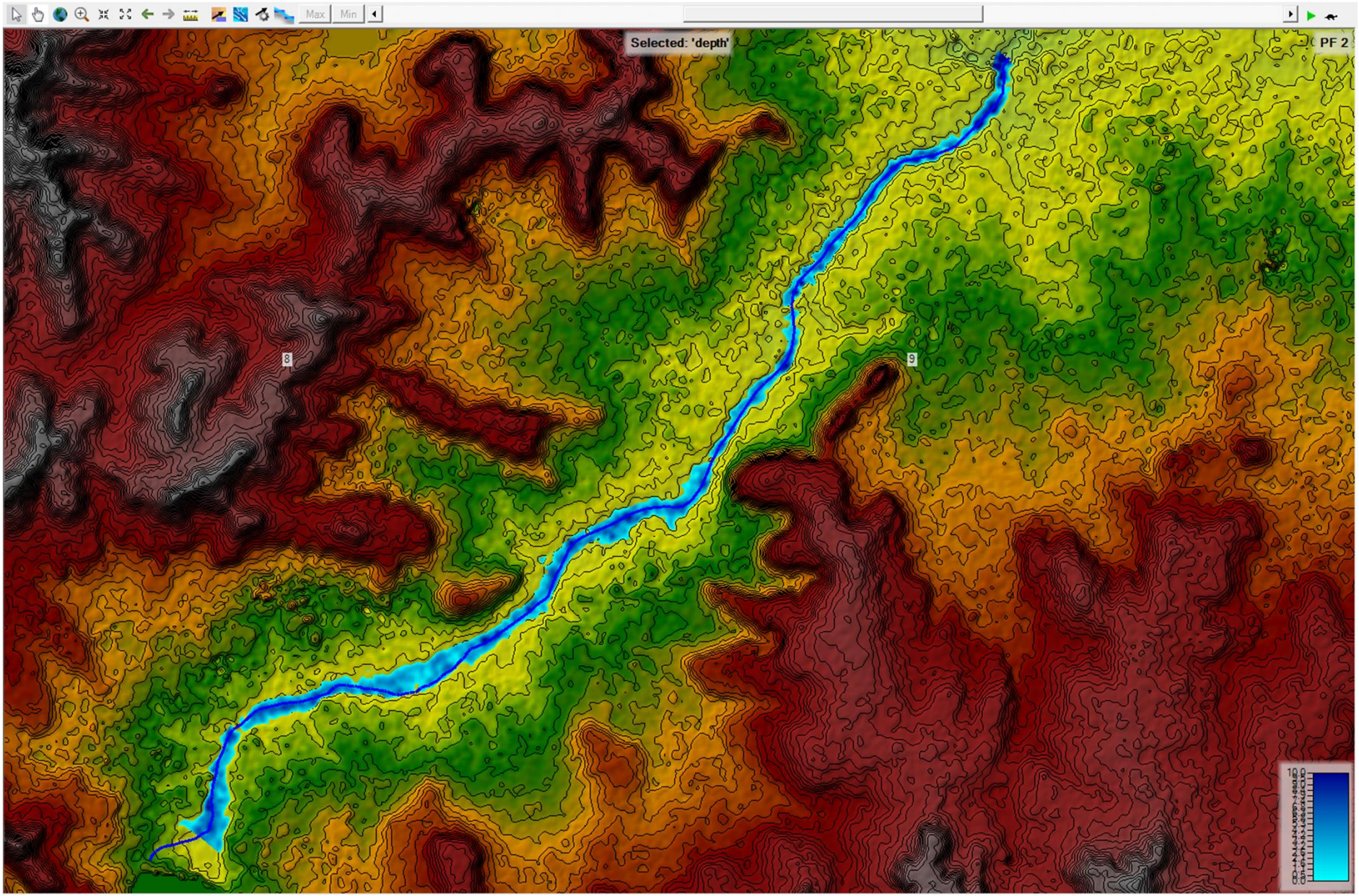


Figure 19: Flood inundation map overlaid on SRTM terrain map for the discharge of 1,00,000 ft3/s covering the entire study reach

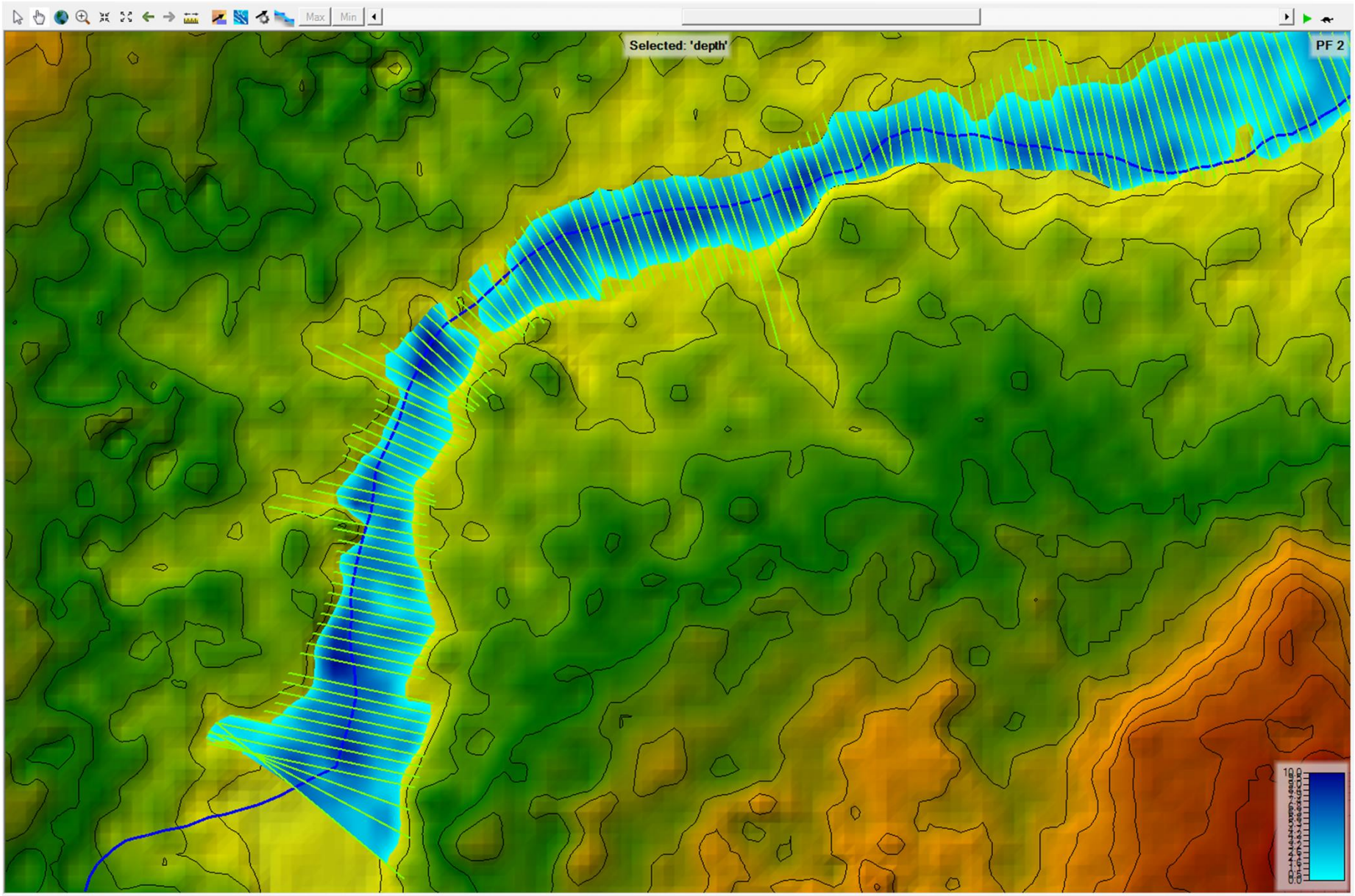


Figure 20: Flood inundation map overlaid SRTM terrain map for the discharge of 1,00,000 ft3/s covering reach from Khadakwasla dam to Nanded city

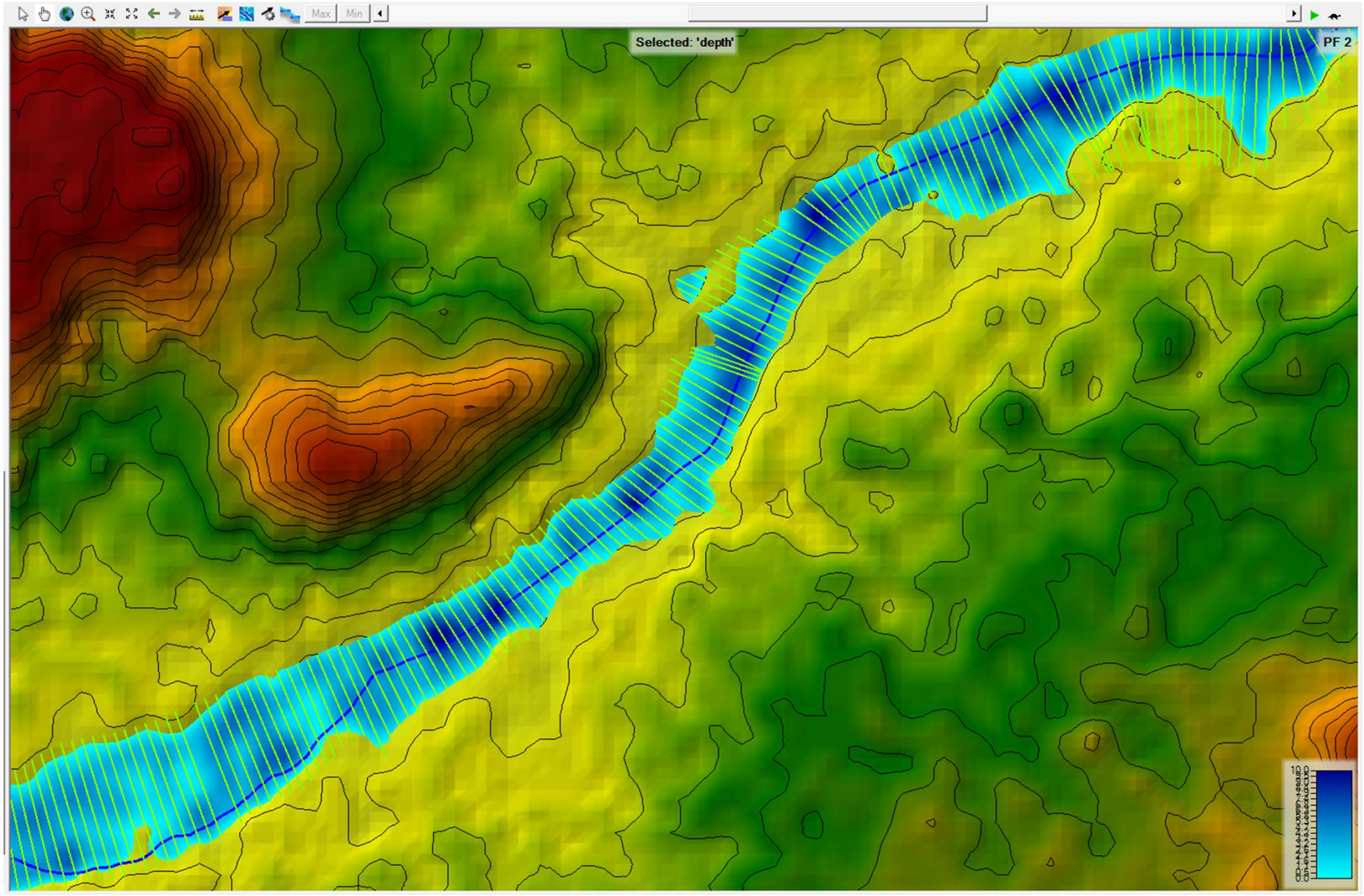


Figure 21: Flood inundation map overlaid SRTM terrain map for the discharge of 1,00,000 ft3/s covering reach from Nanded city to Anand nagar

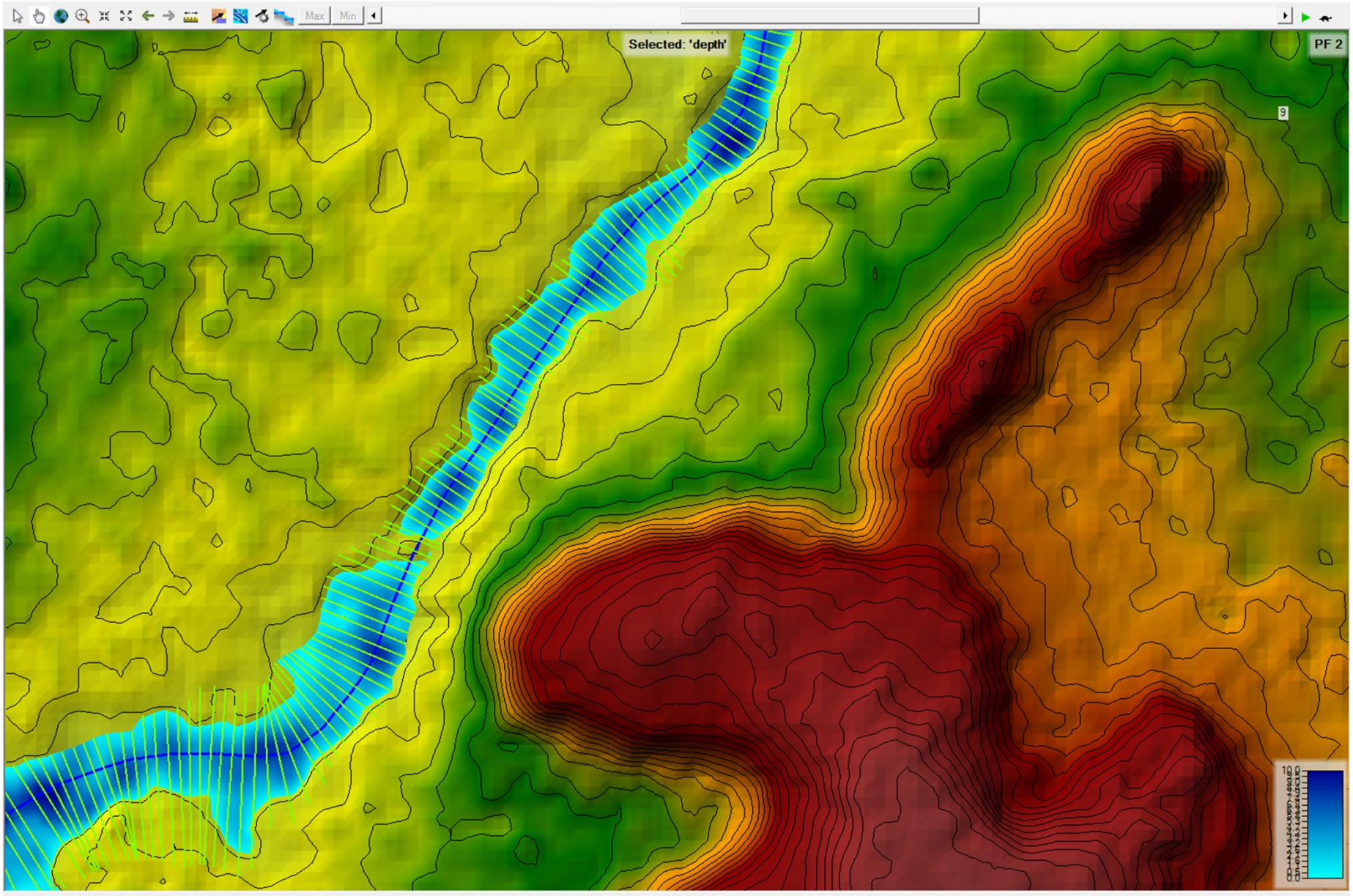


Figure 22: Flood inundation map overlaid on SRTM terrain map for the discharge of 1,00,000 ft3/s covering reach from Anand nagar to Mhatre bridge

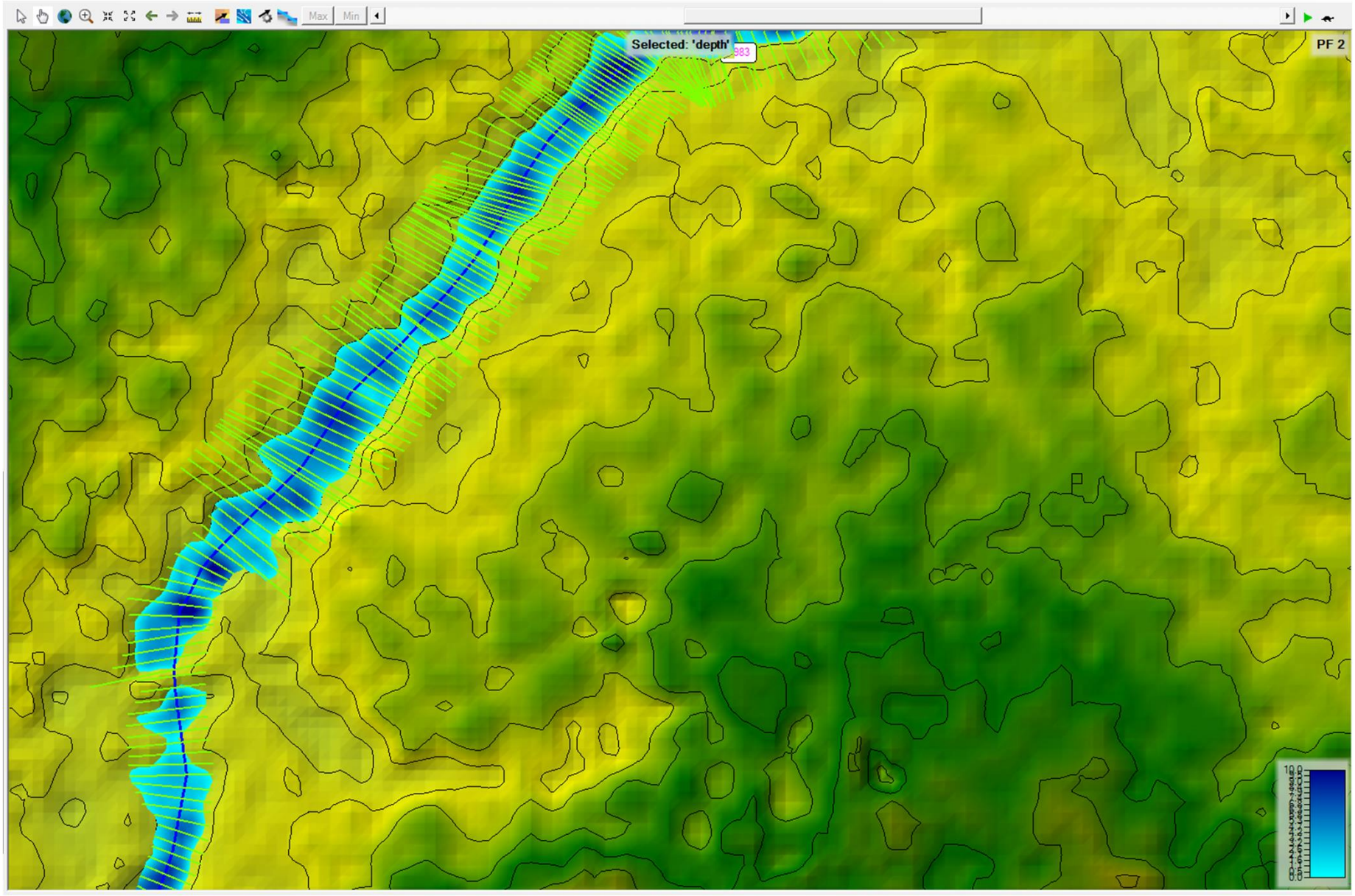


Figure 23: Flood inundation map overlaid on SRTM terrain map for the discharge of 1,00,000 ft3/s covering reach from Mhatre bridge to Tilak bridge

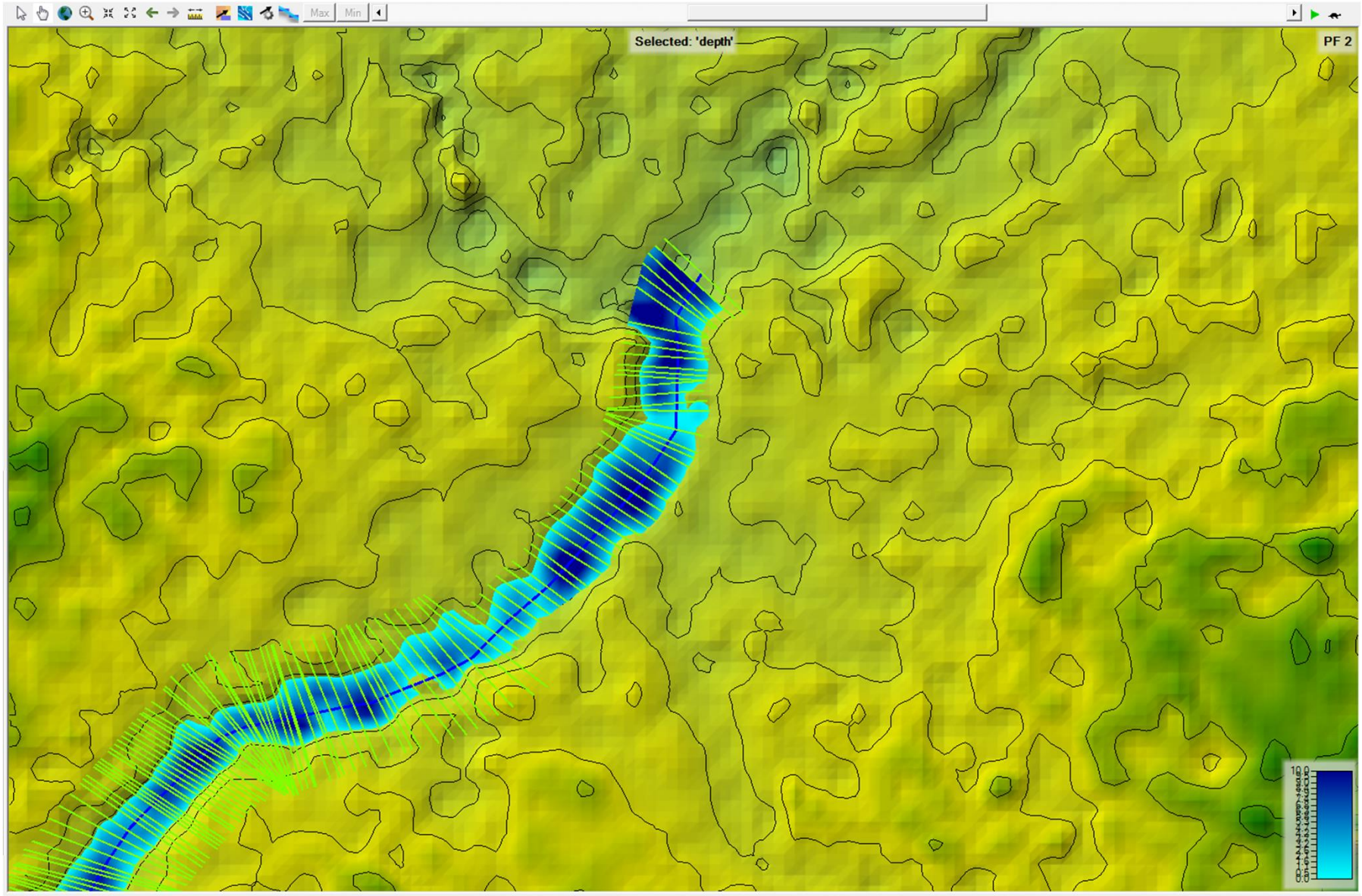


Figure 24: Flood inundation map overlaid on SRTM terrain map for the discharge of 1,00,000 ft3/s covering reach from Tilak bridge to Sangam

Figure 25: The inundation area for the flood discharge of 1,00,000 ft^3/s with and without the Metro piers between Joshi and Shivaji bridge

Figure 26: The inundation area for the flood discharge of 60,000 ft^3/s with and without the Metro piers between Joshi and Shivaji bridge

Annexure-1

HEC-RAS: Model Capabilities

HEC-RAS is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels. The following is a description of the major capabilities of HEC-RAS.

- User interface
- Hydraulic Analysis Components
- Data Storage and Management
- Graphics and Reporting
- RAS Mapper

User Interface

The user interacts with HEC-RAS through a graphical user interface (GUI). The interface provides for the following functions:

File Management
Data Entry and Editing
Hydraulic Analyses
Tabulation and Graphical Displays of Input and Output Data
Reporting Facilities
Context Sensitive Help

Hydraulic Analysis Components

The HEC-RAS system contains four one-dimensional river analysis components for: (1) steady flow water surface profile computations; (2) unsteady flow simulation; (3) movable boundary sediment transport computations; and (4) water quality analysis. A key element is that all four components use a common geometric data representation and common geometric and hydraulic computation routines. In addition to the four river analysis components, the system contains several hydraulic design features that can be invoked once the basic water surface profiles are computed.

Steady Flow Water Surface Profiles

This component of the modeling system is intended for calculating water surface profiles for steady gradually varied flow. The system can handle a full network of channels, a dendritic system, or a single river reach. The steady flow component is capable of modeling subcritical, supercritical, and mixed flow regimes water surface profiles.

The basic computational procedure is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum

equation may be used in situations where the water surface profile is rapidly varied. These situations include mixed flow regime calculations (i.e. hydraulic jumps), hydraulics of bridges, and evaluating profiles at river confluences (stream junctions).

The effects of various obstructions such as bridges, culverts, weirs, etc. in the flood plain may be considered in the computations. The steady flow system is designed for application in flood plain management and flood insurance studies to evaluate floodway encroachments. Also, capabilities are available for assessing the change in water surface profiles due to channel improvements, and levees.

Special features of the steady flow component include: multiple plan analyses; multiple profile computations; multiple bridge and/or culvert opening analyses; and split flow optimization.

Unsteady Flow Simulation.

This component of the HEC-RAS modeling system is capable of simulating one-dimensional unsteady flow through a full network of open channels. The unsteady flow equation solver was adapted from Dr. Robert L. Barkau's UNET model (Barkau, 1992 and HEC, 1997). The unsteady flow component was developed primarily for subcritical flow regime calculations. However, with the release of further Versions, the model can now performed mixed flow regime (subcritical, supercritical, hydraulic jumps, and draw downs) calculations in the unsteady flow computations module.

The hydraulic calculations for cross-sections, bridges, culverts, and other hydraulic structures that were developed for the steady flow component were incorporated into the unsteady flow module.
Special features of the unsteady flow component include: Dam break analysis; levee breaching and overtopping; Pumping stations; navigation dam operations; and pressurized pipe systems.

Sediment Transport/Movable Boundary Computations

This component of the modeling system is intended for the simulation of one-dimensional sediment transport/movable boundary calculations resulting from scour and deposition over moderate time periods (typically years, although applications to single flood events are possible).

The sediment transport potential is computed by grain size fraction, thereby allowing the simulation of hydraulic sorting and armoring. Major features include the ability to model a full network of streams, channel dredging, various levee and encroachment alternatives, and the use of several different equations for the computation of sediment transport.
The model is designed to simulate long-term trends of scour and deposition in a stream channel that might result from modifying the frequency and duration of the water discharge and stage, or modifying the channel geometry. This system can be used to evaluate deposition in reservoirs, design channel contractions required to maintain navigation depths, predict the influence of dredging on the rate of deposition, estimate maximum possible scour during large flood events, and evaluate sedimentation in fixed channels.

Water Quality Analysis

This component of the modeling system is intended to allow the user to perform riverine water quality analyses. An advection-dispersion module is included with this version of HEC–RAS, adding the capability to model water temperature. This new module uses the QUICKEST-ULTIMATE explicit numerical scheme to solve the one-dimensional advection-dispersion equation using a control volume approach with a fully implemented heat energy budget. Transport and Fate of a limited set of water quality constituents is now also available in HEC-RAS. The currently available water quality constituents are: Dissolved Nitrogen (NO3-N, NO2-N, NH4-N, and Org-N); Dissolved Phosphorus (PO4-P and Org-P); Algae; Dissolved Oxygen (DO); and Carbonaceous Biological Oxygen Demand (CBOD).

Data Storage and Management

Data Storage is accomplished through the use of “flat” files (ASCII and binary), as well as the HEC-DSS. User input data are stored in flow files under separate categories of project, plan, geometry, steady flow, unsteady flow, and sediment data. Output data is predominantly stored in separate binary files. Data can be transferred between HEC-RAS and other programs by utilizing the HEC-DSS. Data management is accomplished through the user interface. The modeler is required to enter a single filename for the project being developed. Once the project filename is entered, all other files are automatically created and named by the interface as needed. The interface provides for renaming, mobbing, and deletion of files on a project-by-project basis.

Graphics and Reporting

Graphics include X-Y plots of the river system schematic, cross-sections, profiles, rating curves, hydrographs, and many other hydraulic variables. A three-dimensional plot of multiple cross-sections is also provided. Tabular output is available. Users can select from pre-defined tables or develop their own customized tables. All graphical and tabular output can be displayed on the screen, sent directly to a printer (or plotter), or passed through the Windows Clipboard to other software, as a word-processor or spreadsheet.

Reporting facilities allow for printed output of input data as well as output data. Reports can be customized as to the amount and type of information desired.

RAS Mapper

HEC-RAS has the capability to perform inundation mapping of water surface profile results directly from HEC-RAS. Using the HEC-RAS geometry and computed water surface profiles, inundation depth and floodplain boundary datasets are created through the RAS Mapper. Additional geospatial data can be generated for analysis of velocity, shear stress, stream power, ice thickness, and floodway encroachment data. In order to use the RAS Mapper for for analysis, you must have a terrain model in the binary raster floating-point format (.flt). The resultant depth grid is stored in the .flt format while the boundary dataset is store in ESRI’s Shapefile format for use with geospatial software.

VISION

To be a world-class centre of excellence in hydraulic engineering research and allied areas; which is responsive to changing global scenario, and need for sustaining and enhancing excellence in providing technological solutions for optimal and safe design of water resources structures.

MISSION

- To meet the country's need for basic & applied research in water resources, power sector and coastal engineering with world-class standards
- To develop competence in deployment of latest technologies by networking with the top institutions globally, to meet the future needs for development of water resources projects in the country effectively
- To disseminate information, build skills and knowledge for capacity-building and mass awareness for optimization of available water resources

MAJOR FUNCTIONS

- Undertaking specific research studies relating to development of water resources, power and coastal projects
- Consultancy and advisory services to Central and State Governments, private sector and other countries
- Disseminating research findings and promoting/assisting research activities in other organizations concerned with water resources projects
- Contributions to Bureau of Indian Standards and International Standards Organization
- Carrying out basic and applied research to support the specific studies
- Contribution towards advancements in technology through participation in various committees at National and State Levels

The Director,

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Khadakwasala, Sinhgad Road, Pune 411 024. Maharashtra

Telephone : +91-20-24103400/ 24103500

Fax : +91-20-24381004

Web : www.cwprs.gov.in

महा मेट्रो
PUNE METRO

महाराष्ट्र मेट्रो रेल कॉर्पोरेशन लिमिटेड
MAHARASHTRA METRO RAIL CORPORATION LIMITED
(भारत सरकार आणि महाराष्ट्र शासनाचा संयुक्त उपक्रम)
Joint Venture of Govt. of India & Govt. of Maharashtra
PUNE METRO RAIL PROJECT

Ref No.: Maha-Metro/Pune/EMD/C10 Date: 23rd February, 2021

To,
Regional Deputy Director,
Municipality Administration branch
Office of Divisional Commissioner, Pune

Sub: Minutes of Meeting (MoM) dated 20/11/2019 issued by Divisional Commissioner vide No/NP-4/WS/909/2019 dated 16th December,2019 in matter of NGT Order dated 3rd August,2018 in Original Application No. 130 of 2018 (M.A. No. 343/2018, 344/2018, 345/2018 and 346/2018) (Earlier O.A. No. 67/2018 (WZ)

Ref: CWPRS Technical Report no. 5886 of January, 2021 titled Mathematical Model Studies of River Mutha submitted to your good office vide letter no. Maha-Metro/Pune/EMD/C08 dated 11th January, 2021.

Dear Sir,

In continuation with our earlier submission vide above mentioned reference, The CWPRS has submitted the corrigendum (errata) of the technical report vide letter no. HAPT/Maha-Metro/2021 dated 23rd Feb, 2021. The same is herewith enclosed for your reference please.

23/02/21

(Ratnakar Pandey)
DGM/Environment
Maha-Metro Rail Corporation, Pune

Encl: CWPRS letter no. HAPT/Maha-Metro/2021 dated 23rd Feb, 2021 with Errata report

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और
गंगा संरक्षण विभाग
केन्द्रीय जल और विद्युत अनुसंधान शाला
खड़कवासला, पुणे-411 024

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Department of Water Resources
River Development and Ganga Rejuvenation
CENTRAL WATER & POWER RESEARCH STATION
Khadakwasla, Pune – 411 024

No.HAPT/Maha-Metro/2021 -

Date :

Shri Ratnakar Pandey
Deputy General Manager (Environment)
Maharashtra Metro Rail Corporation Ltd.
1st floor, The Orion Building, Arjun Mansukhani Marg,
Pune-411001

Sub : Corrigenda (Errata) for "Mathematical Model Studies of River Mutha for Maha-Metro Rail Corporation Ltd. Pune".

Sir,

The Corrigenda (Errata) for the technical report no. 5886 of January 2021 entitled "Mathematical Model Studies of River Mutha for Maha-Metro Rail Corporation Ltd. Pune" is enclosed , for reference and record.

Kindly acknowledge the receipt.

Thanking you,

Yours faithfully,

23/02/2021

(Dr. (Mrs) Neena Isaac)
Scientist 'E'

Encl: As above

दूरभाष / Telephone: +91-20-24103331; फैक्स/Fax: +91-20-24381004; ईमेल / Email : neena.isaac@gov.in / n_isaac@rediffmail.com
वेबसाइट/ Website : http://jalshakti-mowr.gov.in, www.cwprs.gov.in

CORRIGENDA (Errata)

to

CWPRS Technical report No. 5886 of January 2021 Titled "Mathematical model studies of River Mutha for Maha Metro Rail Corporation Ltd. Pune"

1. Page 27, Table 7, Column 2: title,

for "Water Surface Elevation after Metro Pier "
read "Water Spread after Metro Pier"

2. Page 27, Table 7, Column 3: title,

for "Water Surface Elevation before Metro Pier "
read "Water Spread before Metro Pier"

3. Page 30, Table 8, Column 2: title,

for "Water Surface Elevation after Metro Pier "
read "Water Spread after Metro Pier"

4. Page 30, Table 8, Column 3: title,

for "Water Surface Elevation before Metro Pier "
read "Water Spread before Metro Pier"

PUNE;

February 23, 2021

May 12, 2021

To,
Dr. Pradeep Thengal
Deputy Commissioner
Municipal Administration,
Pune Division, Pune

Sub: Minutes of Meeting (MoM) dated 20/11/2019 issued vide No/NP.4/WS/ 909/2019 dated 16th December 2019 in matter of NGT Order dated 3rd August, 2018 in Original Application No. 130 of 2018 (M. A. No. 343/2018, 344/2018 345/201/ and 346/2018) (Earlier O. A. No. 67/2018 (WZ)

Ref: Your letter No. NP-4/WS/342/2021 dated 6/4/2021
Minutes of the 7th Meeting dated 08/03/2021

Dear Sir,

With reference to your letter and minutes of the online 7th meeting dated 08/3/2021 under the chairmanship of Divisional Commissioner, Pune, the findings of CWPRS report was discussed in details in the presence of Expert Committee. The comments of the Expert Committee are already mentioned in the above referred minutes. This is for your kind submission and information.

Regards

Expert Committee

Dr. Ritesh Vijay Senior Principal Scientist CSIR-National Environmental Engineering Research Institute, Nagpur	**Dr. A. Benniamin** Scientist – D Maharashtra State Bio-Diversity Board, Pune	**Dr. Y. B. Sontakke** Joint Director, WPC Maharashtra Pollution Control Board, Mumbai

Divisional Commissioner Office, Pune Division,

Council Hall, Pune.

(Municipal Adminisration Branch)

Tele Number:- 020/26362331

email ID-rdmapune@gmail.com

No.NP-4/WS/342/2021

Date :- 6/4/2021

To,

1. Dr. Ritesh Vijay- Principal Scientist, NEERI and convener of the Expert Committee.
2. Dr. A. Benniamin- Scientist, State Biodiversity board, Member of the Expert Committee
3. Dr. Y.B. Sontakke - Joint Director, Maharashtra Pollution Control Board, Member of the Expert Committee

Sub: Minutes of Meeting (MoM) dated 20/11/2019 issued vide No/NP-4/WS/909/2019 dated 16th December,2019 in matter of NGT Order dated 3rd August,2018 in Original Application No. 130 of 2018 (M.A. No. 343/2018, 344/2018, 345/2018 and 346/2018) (Earlier O.A. No. 67/2018 (WZ)

Ref:

1. CWPRS Report shared by this office vide mail dated 13/1/2021 .
2. CWPRS Report shared by Maha-Metro vide mail dated 24.02.2021.
3. Minutes of 7th Expert Committee meeting dated 08.03.2021
4. NGT order passed on dated 28.09.2020 in the matter of IA 83/2020
5. Expert Committee Report dated 13.06.2019
6. Expert Committee Report dated 05.11.2019

With reference to above captioned subject, Maha-Metro was directed to conduct the Numerical Model Study from CWPRS and submit the report to NGT Expert committee at earliest. In compliance to this condition Maha-Metro get this study done through CWPRS and submitted the report to the committee vide reference 1 and 2.

Further, the findings of CWPRS report was discussed and doubts were clarified in the last meeting of the Expert Committee held on 8th March 2021. In the intervening time the applicant has filed a stay application in NGT i.e. I.A. 83/2020 seeking an ad-interim stay of metro construction and further filed two more IAs viz. IA 13/2021 and IA 14/2021 pressing for stay again and early hearing.

Based on the explanation given by Maha-Metro in the matter of IA 83/2020, an order was passed by the NGT dated on 28.09.2020 (Order copy enclosed), wherein the Tribunal has refused to intervene the ongoing Metro construction and directed the committee to submit the report based on the CWPRS technical report before the next date of hearing which is 17.05.2021.

In view of the aforesaid NGT order, The Expert committee is requested to examine the CWPRS report and submit their final comments similarly as submitted earlier vide reference 5 and 6.

O.C.Signed by Divisional Commossioner,Pune Divison Pune.

(Dr.Pradeep Thengal)
Deputy Commissioner,
Municipal Administration,
Pune Division, Pune.

Minutes of the 7th meeting dated 08.03.2021 under the chairmanship of Shri Saurabh Rao Divisional Commissioner, Pune.

Sub: NATIONAL GREEN TRIBUNAL, PRINCIPAL BENCH, NEW DELHI
SARANG YADWADKAR & ORS Vs. PMC & ORS

Quorum (Through Video Conferencing).

1. Dr. Ritesh Vijay -Principal Scientist, NEERI and convener of the Expert Committee
2. Dr. A.Benniamin -Scientist, State Biodiversity Board, Member of the Expert Committee.
3. Dr. Y. B. Sonetakke – Joint Director, Maharashtra Pollution Control Board
4. Mr. Raghunath Mahabal -Advocate, Office of Divisional Commissioner.

Quorum (Physical Presence)

1. Mr. Atul Gadgil - Director (works), Maha Metro Pune
2. Dr Nina Isaac - Scientist E, CWPRS
3. Mr. Prasad Kunjeer - Scientist C, CWPRS
4. Ms Harsha Chaudhary - Scientist B. CWPRS.
5. Mr. Mangesh Dighe - Environment Officer, PMC
6. Ms Renu Gera - Environmental Expert, GC
7. Mr Ratnakar Pandey - DGM Environment, Maharashtra Metro Rail Corporation
8. Mr. Santosh Patil - Manager Maharashtra Metro Rail Corporation
9. Ms. Swati Pandit, Adv. for office of Divisional Commissionar, Pune.

Purpose: Review of the compliance made in accordance with the order dated 03.08.2018 of the Hon'ble NGT wherein, Divisional Commissioner, Pune has been directed to associate with the committee and supervise the project with respect to environmental aspect. It has been kept open for the applicant or any stakeholders to continue to give their suggestions to the committee so that damage to the environment can be prevented or minimized. In case it is found that the project Proponent is not complying with the directions of the committee, the committee will be at liberty to bring the same to the notice of this Tribunal by moving an appropriate application.

Proceedings: This is the 7th Meeting of the Expert Committee Members on Environmental compliance of River front .The last meeting was held on 6.11.2020 wherein the committee was informed that CWPRS Scientist Mr. Prasad Kunjeer who is the lead scientist for the study had been infected by COVID -19 and was hospitalized from 11th -18th October and subsequently on home quarantine till 25th October, hence the study progress was severely hampered, the request

for time extension was placed to the court accordingly NGT has granted the time extension till 12th March 2021.

The meeting commenced with a presentation by CWPRS to the expert committee of the study undertaken is limited to 2.5 km stretch between Khadakwasla dam to Sangam Bridge. At the onset the Expert Committee sought confirmation that the roads and other structure have been considered in study. The CWPRS confirmed the same. The simulations studies to estimate afflux due to construction of Metro piers along the Mutha river bank. This study was carried out on the extended cross section based on drone survey for two discharges of 100,000 cusecs and 60,000 cusecs corresponding to red line and blue line defined by the irrigation department respectively. In addition, inundation depth was also computed and maps were prepared to show inundation depth and extent on both banks.

The major findings from the studies are as below:

1. The maximum afflux (rise in water level) for the 100,000 cusecs and 60,000 cusecs due to introduction of Metro piers have been estimated as 216 mm at Metro pier no. P152 and 241 mm at pier no. DE 1 respectively.
2. This increase in water level results in incremental increase in inundation. Inundation is the spread of the water along both banks (i.e. left bank + right Bank).
3. For the discharge of 100, 000 cusecs the incremental increase in inundation would be insignificant (0.02 m) in the reach between Shivaji Bridge and Shinde Bridge. In the reach between Shinde Bridge and Metro pier DE 8 incremental increase inundation varies between 0.02 to 10 m. Further from DE 8 to Baba Bhide bridge the incremental inundation varies from 2.6 to 10.94 m. (i.e. about 5m on either bank.)
4. At three locations i.e. P159, P160 and Z Bridge the inundation is 22.2 m 20.6 and 29. 8 m respectively. The incremental inundation extent 55.76 m at pier no P167 due to specific topography at this location. There is a low level cross road connecting the river front road and Kelkar road at this location. Water is spreading along this road and hence the higher inundation extent at this particular location was observed.
5. The incremental increase in inundation extent for 60,000 cusecs in the reach between Shivaji Bridge and Shinde Bridge is insignificant (0 to 0.01 m). In the reach between Shinde Bridge and Metro pier DE 8 varies between 0 to 2.27 m. From DE 8 to upstream of Baba Bhide bridge is 2.27 to 11.44 m. At two locations i.e. P162 and P 163 is 10 to 11.4 m. (i.e. 5 to 5.6 m on either bank.)
6. Appropriate mitigation measures to be adopted to reduce the inundation extent at critical points.
7. The Irrigation Department has demarcated the redline for a discharge of 100,000 cusecs and blue line for discharge of 60,000 cusecs in year 2011.The expert committee is of the opinion that the Red line and Blue line to be redefined by the competent authority taking into account the recent developments along the river reach.
8. The CWPRS scientist highlighted in their presentation that the contribution of discharge from the local catchment downstream of the Khadakwasla dam to Sangam Bridge will only

ranted the

yield about 8,500 cusecs corresponding to the discharge of 90,000 cusecs. Therefore, in the worst-case scenario the total discharge will not breach 100,000 cusecs. Also, the spillway design capacity of Khadakwasla dam is 97,000 cusecs only.

9. The CWPRS scientist has also pointed out that in the last 56 years the discharge of 60,000 cusecs has only been breached four times and the 100,000 cusecs has not been breached even once, so scenario for breaching the 100,000 cusec discharge would be a rare.
10. It was referred that the Irrigation Department and the Smart City project both have robust flood alarm and evacuation system to avoid loss of life and property. The Smart City Project has already identified the flood prone locations and areas to where people will be moved in case of floods. This has been tested during the floods of 2019.
11. The CWPRS has stated that they have submitted their final report based on the available data. If there would be any further requirement, CWPRS can take up additional studies.

The expert committee has pursued that Maharshtra Metro Rail Corporation through Central Water and Power Researeh Station (CWPRS) have conducted all studies and submitted reports as directed by the committee. Maha Metro is taking utmost care during construction of Project and complying all the guidelines issued by Expert Committee. There is no impediments in proceeding with work by Maha Metro.

The meeting concluded formally with a vote of thanks.

NO/NP-4/WS/260/2021
Date:30/3/2021

(Saurabh Rao)
Divisional Commissioner, Pune.
Division Pune.

1. Mr. Atul Gadgil - Director (works), Maha Metro Pune
2. Dr Nina Isaac - Scientist E, CWPRS
3. Mr. Prasad Kunjeer - Scientist C, CWPRS
4. Ms Harsha Chaudhary - Scientist B, CWPRS.
5. Mr. Mangesh Dighe - Environment Officer, PMC
6. Ms Renu Gera - Environmental Expert, GC
7. Mr Ratnakar Pandey - DGM Environment, Maharashtra Metro Rail Corporation
8. Ms. Swati Pandit, Adv. for office of Divisional Commissionar, Pune.
9. Mr. Santosh Patil - Manager Maharashtra Metro Rail Corporation
10. Dr. Ritesh Vijay -Principal Scientist, NEERI and convener of the Expert Committee
11. Dr. A.Benniamin -Scientist, State Biodiversity Board, Member of the Expert Committee.
12. Dr. Y. B. Sonetakke – Joint Director, Maharashtra Pollution Control Board
13. Mr. Raghunath Mahabal -Advocate, Office of Divisional Commissioner.

Exhibit "4"

सत्यमेव जयते

महाराष्ट्र शासन

जलसंपदा विभाग

अधीक्षक अभियंता, पुणे पाटबंधारे मंडळ, पुणे

सिंचन भवन, मंगळवार पेठ, पुणे-४११०११

दूरध्वनी क्र. ०२०-२६१२ ६९४१
२६१२ ६२८९
Email:sepicpune@gmail.com

जा.क्र.:पुपामं/ धा.क्र.७२/२०२०)/ प्रशा-४/पूर समिती-Metro data/ ९१९८ /२०२१.   दिनांक :२२/०३/२०२१

प्रति,
मा. कार्यकारी संचालक,
महाराष्ट्र मेट्रो रेल कार्पोरेशन लि.
पुणे मेट्रोरेल प्रोजेक्ट, पुणे - ४११००१.

विषय :- **भीमा खोऱ्यात सन २०१९ मध्ये उदभवलेल्या पुरपरिस्थितीची कारणे शोधणे व भविष्यकालीन उपाय योजनात्मक अहवाल तयार करण्यासाठी स्थापन केलेल्या समितीच्या अहवालाकरिता माहिती उपलब्ध करुन देण्याबाबत ...**

संदर्भ :-
१) शासन निर्णय क्र.पूरनि-२०२०/प्र.क्र.१४५/२०२०/सिंव्य(म), दिनांक २७/१/२०२१
२) Government letter no Sec (CAD)/Flood Committee Meet./01/2021, Dt.08/03/2021
3) Government letter no Sec (CAD)/Flood Committee Meet./02/2021, Dt. 19/03/2021

उपरोक्त संदर्भ क्र. १ चे शासन निर्णयाद्वारे भिमा व कृष्णा खोऱ्यात सन २०१९ मध्ये उद्भवलेल्या पुरपरिस्थितीचां कारणे शोधणे व भविष्यकालीन उपाययोजनात्मक अहवाल तयार करण्यासाठी मा. राजेंद्र पवार, (सेवानिवृत्त सचिव,(लाक्षेवि), जलसंपदा विभाग) यांचे अध्यक्षतेखाली सुधारीत समिती गठित करण्यात आली आहे.

संदर्भीय पत्र क्र. २ अन्वये, सदर समितीचे दि.१२/०३/२०२१ रोजी जलसंपत्ती भवन, कोथरूड, पुणे येथे संपन्न द्वितीय बैठकीमध्ये, मुठा नदीपात्रामध्ये पुणे मेट्रोचे स्तंभ उभारण्यात आल्याने निर्माण होणाऱ्या Afflux चे आकडेमोड करणेस्तव सी.डब्लू.पी.आर.एस. मार्फत करण्यात आलेल्या अभ्यासासंदर्भात सी. डब्लू. पी. आर. एस. यांचे प्रतिनिधींकडून सादरीकरण करण्यात आले आहे.

सदर सादरीकरणानुसार मुठा नदीपात्राकरिता सी. डब्लू. पी. आर. एस. मार्फत बनविण्यात आलेले अहवाल व मॉडेलचा वापर भिमा उपखोऱ्याचा पूर अभ्यास करण्यास्तव वापरण्यात यावा, असे निर्देश मा. अध्यक्ष महोदय, भिमा खोरे, पूर समिती यांनी संदर्भीय पत्र क्र. ३ अन्वये सदर समितीचे दि.२२/०३/२०२१ रोजी संपन्न बैठकीमध्ये दिले आहेत. त्यानुषंगाने पुणे मेट्रो प्रकल्पाकरिता सी.डब्लू.पी.आर.एस. मार्फत करण्यात आलेले अहवाल, मॉडेल व अनुषंगिक माहिती समितीस उपलब्ध करून देण्यात यावी, हि विनंती.

सोबत :- वरीलप्रमाणे

Chopade 22/3/21
(सं. द. चोपडे)
अधीक्षक अभियंता,
पुणे पाटबंधारे मंडळ,पुणे-११

O/C

प्रत : मा. संचालक, सी.डब्लू.पी.आर.एस.,खडकवासला, पुणे यांना माहिती व पुढील कार्यवाहीस्तव सविनय सादर.

प्रत : सहाय्यक अभियंता श्रेणी – १, तपासणी पथक उपसा सिंचन योजना (यांत्रिकी), पुणे यांना माहिती व पुढील कार्यवाहीस्तव

२/- उपरोक्तप्रमाणे मुठा नदीपात्राकरिता सी. डब्लू. पी. आर. एस. मार्फत बनविण्यात आलेले अहवाल व मॉडेल संबंधीतांकडून उपलब्ध करून घेण्यात यावी व समितीस विहित कालमर्यादेत सादर करावी.

महा मेट्रो
PUNE METRO

महाराष्ट्र मेट्रो रेल कॉर्पोरेशन लिमिटेड
MAHARASHTRA METRO RAIL CORPORATION LIMITED
(भारत सरकार आणि महाराष्ट्र शासनाचा संयुक्त उपक्रम)
Joint Venture of Govt. of India & Govt. of Maharashtra
PUNE METRO RAIL PROJECT

Ref No.: Maha-Metro/Pune/EMD/C11

Date: 23rd March, 2021

To,
Superintending Engineer,
Pune Irrigation Division,
Sinchan Bhawan, Mangalwar Peth
Pune- 411011

Ref: पुपांम/धा.क्र.७२ /२०२०)/प्रशा-४/पूर समिति-Metro data /१९१८/२०२१, दिनांक:२२/०३ /२०२१

Dear Sir,

Reference to your office letter cited above, please find enclosed CWPRS technical Report no. 5886, January, 2021 for your reference. This study was conducted to fulfill the recommendation of the Expert Committee in matter of NGT Order dated 3rd August,2018 in Original Application No. 130 of 2018 (M.A. No. 343/2018, 344/2018, 345/2018 and 346/2018) (Earlier O.A. No. 67/2018 (WZ).

23/03/21

(Ratnakar Pandey)
DGM/Environment
Maha-Metro Rail Corporation, Pune

Encl: CWPRS Technical Report no. 5889, January 2021

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

WESTERN ZONE BENCH AT PUNE

INTERIM APPLICATION NO. 13 OF 2021

IN

ORIGINAL APPLICATION NO. 28 OF 2020

(WZ)

Sarang Yadwadkar & Ors …Applicants

Versus

Pune Municipal Corporation and Ors

…Respondents

AFFIDAVIT-IN-REPLY OF RESPONDENT NO.6

==========

Dated this 16 day of June 2021

PRALHAD PARANJAPE
Advocate for Respondent No.6
116, Motlibai Wadia Building,
22-D, S.A. Brelvi Road,
Fort, Mumbai – 400001
O.S. Reg. No.11297
Advocate Code - I4068
Email: pralhad.pd@gmail.com
9890673278