DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WA 99362-1876

07 July 2017

SUBJECT: Technical assistance report – Flood response options for the city of Hailey, Idaho

Brigadier General Brad Richy
Director, State of Idaho Office of Emergency Management
4040 West Guard Street, Building 600
Boise, Idaho 83705-5004

Dear General Richy;

1. REFERENCES.
   a. Engineer Regulation 500-1-1, Civil Emergency Management Program.
   c. Teleconference conducted on 8 June 2017, with City of Hailey, Blaine County, and Idaho Office of Emergency Management, subject: Technical assistance for the City of Hailey, Idaho.

2. PURPOSE AND INTENT.
   a. Mission. Assess current river conditions, and identify options for city officials to address immediate and short term flooding issues from the Big Wood River.
   b. Objectives.
      (1) Immediate.
         (a) Investigate river conditions, and assess impacts from any changes in the stream channel. This was not a flood plain survey, but an inventory of stream alterations due to the recent flooding, with any apparent changes to the existing flood plain documented.
         (b) Identify feasible options to dewater designated areas for life and safety purposes. This could involve diverting flows, pumping water from low lying areas, or a combination of both.
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(2) Short-term. Identify temporary measures that may be possible for flooding in 2018, even though the flood potential in 2018 is unknown.

c. Planning assumptions.

(1) The team assumed a moderate flood stage at the Hailey gage, in consultation with city officials.

(2) Some options may not be feasible or possible after due consideration.

3. BACKGROUND. Snow pack in the Big Wood River basin was 240% of normal on 1 April 2017. Localized flooding began in Blaine County, downstream of Magic Reservoir, on 31 March 2017, and the county declared an emergency on 11 April 2017. Flooding began in Sun Valley on or about 6 May 2017. The flooding persisted through June, and was on going when the technical assistance team arrived on 11 June 2017. Hailey was flooded badly, particularly in the Della Vista residential area. The same area was flooded from the Big Wood after an avalanche in February, and again in May through June from overbank flooding from snowmelt. The extent and duration of the flooding drove the request for technical assistance by the city.

4. REPORT SUMMARY. The full report is under Annex B.

a. The primary objective of the field visit was to investigate current river conditions, and assess changes in the stream channel and impacts from these changes. The team was also tasked with identifying feasible options for lessening ongoing flooding impacts and risks. Finally, the team was tasked with identifying potential temporary measures that may be possible to employ in order to reduce flood damage and life safety risks in the short-term (i.e., 2018 runoff season).

b. During the mission, the team observed moderate flows leaving the main channel from numerous locations along the left bank, primarily downstream of the Bow Bridge, and flowing overland towards the Della View residential area. These flows were ongoing during the site visit, even though the river was well below flood stage (averaging less than 3,000 CFS at the time). Significant evidence of additional recent overland flows that had receded by the time of the site visit were also observed. Other areas further from the river were also being flooded from overland flows along various distributary paths, extending into areas north of Snowfly Drive. These are not in the current FEMA floodplain delineation.

b. From these and other factors, in addition to the anecdotal accounts of Hailey staff, there appears to have been a reduction of conveyance capacity in the Big Wood River in the reach downstream of the Bullion St. Bridge. It appears probable that this reach (between the Bullion St. Bridge and the Della View residential area) has experienced sufficient reduction in conveyance capacity such that flood waters could be escaping the main channel more frequently in the future than they were previously.
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This results in greater flood damage risks in and around Della View, and possibly on a more frequent basis.

c. A list of possible actions was then presented to city representatives for discussion. Several of the actions were ruled out as inappropriate for the specific location. These included such actions as construction of a dam upstream, since it would be prohibitively expensive for the limited population and properties it would provide flood risk management benefits to, in addition to the likely unacceptable ecological impacts. Similarly, significant channelization of the river or construction of levees were judged to likely be unacceptable to the community.

d. The final list is under Annex B, and is broken into short-term, and long-term actions. These include both structural and non-structural options, either as a response (e.g., temporary flood barriers), or mitigation (e.g., relocation of mechanical equipment).

e. The team also reviewed actions by the City of Hailey throughout the flood season. These are listed under Appendix A of Annex B, and describe pre-flood event preparations that set the stage for the subsequent flood response. This included conducting internal tabletop exercises. These reflect a community that has an emergency operations plan, and was prepared to respond well in advance of the flood event.

5. RECOMMENDATIONS.

a. The City of Hailey request a new flood study to capture recent changes to the flood risks of the community through the Idaho Flood Plain Management Program.

b. Request the U.S. Army Corps of Engineers (USACE) assistance to investigate the identified channel morphological changes, and the implementation of the potential actions identified by the team, under existing USACE authorities (see Annex C).

c. Continue the use of the city emergency operations plan, and conduct an after action report of the flood event to develop an improvement plan.

d. Consider stockpiling sufficient flood fight materials to provide temporary flood protection until long term actions can be implemented for the apparent change in channel morphology. Alternatively, stockpile enough flood fight materials for an initial response, and identify sources that can provide additional materials in a timely fashion upon request.

6. REPORT PREPARATION

a. This report was prepared by Mr. Jeffery Stidham, Readiness Office, 509.527.7145, Jeffery.L.Stidham@usace.army.mil.
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b. Annex B was prepared by Ms. Joy Hartl, Joy.G.Hartl@usace.army.mil, 509.527.7613 and Mr. Darrell Eidson, Darrell.E.Eidson@usace.army.mil, 509.527.7291

7. POINT OF CONTACT. Points of contact for this report are

a. Mr. Val Bogdanowitz, Chief of Readiness Office, 509.527.7041, Val.P.Bogdanowitz@usace.army.mil.

b. Mr. Brandon Hobbs, Idaho Outreach Coordinator, 208.433.4463, Brandon.W.Hobbs@usace.army.mil.

c. Mr. Tatton Suter, Planner, 208.433.4466, Tatton.L.Suter@usace.army.mil.

DAMON A. DELAROSA
Lieutenant Colonel, EN
Commanding

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Annex A: Hailey Technical Assistance Mission Scope
Annex B: Hailey Technical Assistance Field Report
Annex C: USACE planning assistance authorities
ANNEX A: HAILEY TECHNICAL ASSISTANCE MISSION SCOPE
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Annex A: Hailey Technical Assistance Mission Scope

1. CURRENT SITUATION.

a. The City of Hailey has been flooded from the Big Wood River since 6 May 2017. The flooding was caused by the run-off from an unusually deep snowpack, and is expected to persist into July. The flooding has risen and fallen due to weather conditions. The stream channel has apparently changed, altering the flood plain, and lowering the flood level for parts of Hailey. Direct access to the flooded areas and changed channel is difficult because the water is deep in some parts of the subject area.

b. Some areas in the community have been continuously flooded (e.g., War Eagle and Cedar Bend Drives) since 6 May 2017, while other areas have flooded intermittently, from stream fluctuations. Infrastructure damages are certain, and some services have been shut down (e.g., power and sewer). Travel through the area is unsafe. Emergency services can't be provided safely, nor can damage assessments and recovery operations proceed, until the flood waters recede or are diverted.

2. MISSION. Deploy two U.S. Army Corps of Engineers (USACE) employees to Hailey, Idaho by 13 June 2017, to assess current river conditions, and identify options for city officials to address immediate and short term flooding issues.

3. SCOPE.

a. Immediate.

(1) Investigate river conditions, and assess impacts from any changes in the stream channel. NOTE: This is not a flood plain survey, but is an inventory of stream alterations due to the flooding. However, any apparent changes to the existing flood plain should be documented.

(2) Identify feasible options to dewater designated areas for life and safety purposes. This may involve diverting flows, pumping water from low lying areas, or a combination of both. NOTE: City officials understand that this may not be feasible, or even possible.

b. Short-term. Identify temporary measures that may be possible for flooding in 2018. NOTE: The flood potential in 2018 is unknown. Assume a MODERATE flood stage at the Hailey gage. Confer with city officials as to the exact flows.

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Annex A: Hailey Technical Assistance Mission Scope

   d. Personnel safety. Personnel safety is paramount. Team members will use their discretion on when and how to proceed with their field investigations. They may refuse to enter any given area. The city and county will provide support and rescue services.

   e. Drone Support. Drone support will enhance the field investigation. USACE can’t get one in the short window available.

4. SUPPORT REQUIREMENTS.

   a. Foot travel through flood waters may be needed, at the discretion of the USACE team members. They will bring chest waders and personal flotation devices.

   b. State or local support is requested for drone support.

   c. Site specific maps will be provided, in hard copy, as they are available. NOTE: Walla Walla District will task our GIS section for maps, but the city is likely to have better ones.

   d. The team will have a guide and/or liaison from the city or county at all times during working hours.

5. COMMUNICATIONS.

   a. Primary point of contact is Ms. Carol Brown, City of Hailey, Idaho, 208.720.4122 (personal number, do not publish), carol.brown@hailey.cityhall.org.

   b. Alternate point of contact is Mr. Chris Corwin, Blaine County Emergency Coordinator, 208.859.9618, ccorwin@co.blaine.id.us.

   c. State of Idaho point of contact is Mr. Gary Davis, Area Field Officer, 208 308-2961, gdavis@imd.idaho.gov.
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Annex C: USACE Planning Assistance Authorities

ANNEX B: HAILEY TECHNICAL ASSISTANCE FIELD REPORT
Introduction

The portions of the City of Hailey began experiencing flooding from the Big Wood River starting on 6 May 2017. The flooding was caused by the run-off from an unusually great amount of snowpack, and is expected to persist for quite some time, potentially into July. The amount of flooding has risen and fallen in response to weather conditions, with some areas that have been continually inundated since early May and others that have experienced intermittent flooding.

Flooding behavior suggests that the stream channel has apparently changed, altering the flood plain, and lowering the threshold of flood damages for parts of Hailey. Direct access to the flooded areas and changed channel is difficult because of the depth of water some parts of the subject area. The extent of flood waters in some areas have inhibited emergency response services, damage assessments and recovery operations.

Mission

Two USACE-NWW technical staff were deployed to Hailey the week of 12 June 2017 to assess current river conditions, and identify options for city officials to address immediate and near-term flooding issues.

Scope

The primary objective of the field visit was to current investigate river conditions, and assess changes in the stream channel and impacts from these changes. In addition, the team was tasked with identifying feasible options for lessening ongoing flooding impacts and risks. Finally, the team was tasked with identifying potential temporary measures that may be possible to employ in order to reduce flood damage and life safety risks in the short-term (i.e., 2018 runoff season).

Observations

Previous Measures

Prior to NWW arrival in mid-June, the city had already undertaken a number of measures, both strategic and tactical, to prepare and reduce the damaging impacts of the anticipated high river runoff. These measures included advanced review of the City’s Emergency Operation Plan, acquisition of sandbags and protective gear for City staff, substantial outreach to residents starting months prior to expected runoff peak including public meetings, establishment of an Incident Command Team, and continued public communications via Facebook page. During the actual flooding, the City partnered with other local governments, such as Blaine County and nearby communities, closed roads and shut down utilities, marked high-water extents, protected City infrastructure such as the sanitary sewer lift station near Heagle Park, and performed road repairs as access became available. A more comprehensive list of actions taken before and during flooding are included in Appendix A.
UAV Imagery

The team arrived at Hailey, ID, the evening of 11 June 2017, and met with city representatives the following morning. Following introductions, the city presented a video of recent aerial imagery obtained from a UAV (drone), that clearly showed significant overbank flows escaping the channel on both sides of the Big Wood River, extensive woody debris jams in the downstream end of the reach, and the overland flow paths of the primary source of the neighborhood flooding in the Della View area. The video showed the river reach from Lions Park (located on west overbank below Croy Creek Rd./Bullion St. Bridge) downstream to near the city’s former wastewater treatment facility location, as well as through much of the inundated neighborhoods on the east side of the river.

USGS Gage Information

During the meeting with city representatives, the City Engineer and others reported that the discharge-stage relationship has apparently shifted. City officials monitor the USGS gage height reported for gage number 13139510 to ascertain potential flood risks. Flood stage at this gage location, at the Bullion St. Bridge, is listed at 6 ft. (This gage height equates to a discharge of about 4,000 cfs – see discussion below.) The measured gage heights have been above this level numerous times and for extended periods this year since the current annual runoff peak in early May (Figure 1). City representatives reported that flood impacts seemed to be occurring at notably lower stages recently.

Figure 1. USGS Reported Gage Height, Big Wood River at Hailey, ID
Review of the USGS reported discharges shows that they track well with the reported stages (Figure 2). However, the discharges reported are derived from stage-discharge relationships developed from periodic field measurements. Reported gage heights and corresponding discharges had dropped by the time NWW staff arrived on site, with mean daily flows of less than 3,000 cfs by the 12th of June, when NWW staff began field work.

![Figure 2. USGS Reported Discharge, Big Wood River at Hailey, ID.](image)

Upon returning to the NWW District office, the USGS field measurements for the gage, from May of 2005 through June of 2017, were downloaded, imported into a spreadsheet, and evaluated. Sorting the data, based on the measured gage height, shows a departure in the recent gage height response to discharge (Figure 3). Measurements depart significantly from the trend, and can be seen with the three most recent values, from June of 2017, circled in red.
Field Observations

District staff toured the Big Wood River reach downstream of the Bullion St Bridge, utilizing chest waders to negotiate deeper overbank stages, and observed moderate flows leaving the main channel from numerous locations along the left bank, primarily downstream of the Bow Bridge, and flowing overland towards the Della Vista residential area. The active escaping flows were ongoing during the site visit, even though the river was well below flood stage and flows were only averaging less than 3,000 cfs at the time. Significant evidence of additional recent overland flows that had receded by the time of the site visit were also observed. Overland flows were entering residential areas at several locations, but one of the most significant appeared to be along Cedar St. where the Draper/Wood River Land Trust recreational trail intersected it (refer to Appendix D map for spatial reference points). These flows were then travelling mostly down Cedar St./War Eagle Dr. before re-entering the river through Heagle Park south of War Eagle Dr. (Photo 1). Significant erosion was occurring at this location, as flood waters departed War Eagle Dr., leaving exposed utilities. Other areas further from the river were also being flooded from overland flows along various distributary paths, extending into areas north of Snowfly Dr. which are not in the current FEMA floodplain delineation. Significant sediment deposits were noted at numerous locations, both within the Wood River Land Trust property as well as in residential areas (Photo 2). Many of the utility boxes were inundated, and city staff reported that services had been turned off when flooding began impacting the residential area, and were still off.

Figure 3. Departure of Recent Gage Height-Discharge Relationship. Circed Values Are All June 2017 Measurements.

y = 0.1119x^{0.4818}
R^2 = 0.9969

Gage Ht vs. Discharge

Gage Ht (ft)
Discharge (cfs)

Gage Ht
Power (Gage Ht)
A number of additional factors support the conclusion that a reduction of conveyance capacity in the Big Wood River in the reach downstream of the Bullion St. Bridge had occurred, in addition to the anecdotal accounts of Hailey staff. In 2013, the Beaver Creek wildfire burned more than 110,000 acres in the Big Wood River watershed in Blaine County, Idaho. The large, relatively recent fire has resulted in substantially higher than normal sediment yields from the watershed upstream of Hailey. The city’s public relations representative is a retired USFS employee, and reported that fire recovery actions (e.g., revegetation) on the affected Deer Creek tributary had “blown out” three times since the fire (Brown, 2017). NWW District staff previously deployed to assess flood impacts from an unusually high snowpack this year also have noted extensive erosional damages, such as on Warm Springs, for example, a tributary to the Big Wood River upstream of Hailey (Photo 3).
The Big Wood River flows along the base of a steep bluff, across from the Della View residential area, that is prone to avalanche in the winter months. Indeed, City staff reported that an avalanche had occurred during the past winter near the tennis court at Heagle Park. These avalanches likely transport debris and sediment into the river channel when they occur, and the typically-lower river discharges when they happen would not be expected to be capable of readily mobilizing such surcharge materials. In addition, any ‘damming’ of the river from the avalanche would likely incur deposition of sediments in transport until the blockage cleared.

The City also provided an excerpt from a geomorphic assessment performed by Biota Research and Consulting (date unknown) for the reach downstream of the Bullion St. Bridge. The median diameter of the active bed is comprised of material in the 64-90 mm size class, with roughly 25% in this size range and the largest material greater than 258 mm. The bed materials are considered to be sufficiently coarse in the report to limit further incision, noting there are few scour pools within the reach, though bankfull hydraulic energies were estimated to be sufficient to mobilize up to 125 mm particles (~D75). The report estimates that bank erosion in the reach contributes almost 600 tons/yr., on average, of fine sediments to the river. Overall, this document notes that, though the incised reach is capable of mobilizing the majority of sediment sizes found in the bed, the channel has insufficient capacity to transport the
sediment supplied to the reach, and is categorized as aggradational, resulting in excess sediment deposition (Biota).

Interestingly, one of the photos in the Biota report excerpt references a “failing rock sill structure”. Further inquiry revealed that this structure was constructed around 2001, just downstream of the Bullion St. Bridge, as part of a channel restoration project that included bankline slope reduction and setback (Boettger, 2017). The Big Wood River experienced a peak of around 7,900 cfs, the highest recorded at the Hailey gage since 1915, which could have initiated failure of the rock sill. However, such a structure could also lead to aggradation in the reach upstream while intact. It is possible that materials that might have accumulated upstream of this structure have not been moved through the Bullion Bridge reach yet.

Taking all of the above as context, it appears probable that the reach between the Bullion St. Bridge and the Della View residential area has experienced sufficient reduction in conveyance capacity that flood waters are escaping the main channel more frequently than they were previously, resulting in greater flood damage risks at/near Della View. The City Engineer provided a map of surveyed high-water markers established near the peak of flooding during this year’s event, included as Appendix B. This will be valuable in assessing the magnitude of change that could be expected if this condition persists, or advances.

Recommendations

Possible Actions

Prior to departing the field visit, NWW staff assembled a list of potential actions for preliminary consideration in reducing flood damages to the Della View area, and are included as Appendix C. The list is broken into two subsets: 1) Short Term for actions that could be undertaken quickly, and 2) Long Term for actions that would require substantial planning and design (except for the no action item). A significant number of these actions originated from concepts provided by the City Engineer and other technical representatives. The remainder arose from brainstorming of measures that have been successfully employed for flood damage reduction in other locations, and these were not initially screened for suitability in Hailey. A short list of some relative categorical identifiers that were estimated to characterize such an action were added to the list and assigned to the items on the list.

The list was then presented to City of Hailey representatives for discussion. As anticipated, several of the actions were ruled out as inappropriate for the specific location. These included such actions as construction of a dam upstream, since it would be prohibitively expensive for the limited population and properties it would provide flood risk management benefits to, in addition to the likely unacceptable ecological impacts. Similarly, significant channelization of the river or construction of levees were judged to likely be unacceptable to the community.

Conversely, a subset of the listed actions generated significant interest and discussion, and were highlighted on the list for further consideration.

Short Term Actions

For short term actions to consider for near-term implementation, dredging of the channel in the reach between Bullion St. and the Della View neighborhood would most likely have immediate benefits in
restoring the channel capacity that has in all probability been reduced from sediment deposition associated with one or more of the likely drivers cited above. It is unclear, at this point, how effective this would be over the longer term, since it is not well understood if this is a transitory response to recent (e.g., post-fire sediment loading, avalanche debris loading) or a longer-term channel adjustment phenomenon. Such an action could entail substantial expense, and would require regulatory coordination.

A second strategy would be to deploy a temporary barrier to contain and redirect escaping overbank flows back to the channel. Because of the low-magnitude depths of escaping flows in most locations, a relatively low-impact barrier could be put in place using, for example, a frame-and-membrane assembly used to construct cofferdams for in-channel construction of hydraulic structures, as shown in Figure 4. For those areas that experience more significant depths or flow energy, a more robust but still quickly assembled fillable barrier could be employed, such as those manufactured by HESCO (Figure 5). A combination of barrier types could be required, with the more robust barriers at select locations, and frame-and-membrane type temporary cofferdams connecting between these. Such a barrier configuration would require minimal disturbance to existing vegetation in the Land Trust property, where much of the damaging flood waters escape, by utilizing the available foot paths, and could be deployed only when high flows are anticipated. The temporary nature of this measure would likely make it more acceptable to the larger community, since recreational uses of the Land Trust property would only be impacted for short periods. Confinement and redirection of escaping flows back to the river channel would have the added benefit of confining the river’s hydraulic energy to the channel, where it would be more likely to mobilize sediments and create lost conveyance capacity.
Figure 4. Temporary Cofferdam.

Figure 5. Example Fillable Barrier (HESCO).
**Longer Term Actions**

A more permanent version of the temporary barrier strategy discussed above would involve raising the hiking trail through the Land Trust preserve to function in the same way by confining and redirecting escaping overbank flows back to the main channel, with similar benefits. Implementation of this would also offer additional protection to the sewer line that runs beneath the foot path (though this infrastructure does not at significantly risk from erosional damage in this area at present), while maintaining the original purpose of the trail.

Several of what are classified as *non-structural* options by USACE were included in the initial list, and include such actions as flood proofing of homes (*e.g.*, higher first-floor elevation, relocation of mechanical equipment) that have already been undertaken by individual homeowners in many of the affected areas. One relatively straightforward, though not low-cost, approach is to simply buy out properties in the flood plain. In discussing this option, a variation on this was suggested during the meeting – purchase of undeveloped lots within the affected area. This variation, while still of potentially significant cost, clearly offers some savings over purchase of constructed residences. In addition, buyouts and other non-structural measures are typically only effective in reducing/eliminating damages at the specific location, as opposed to more widespread benefits to other properties from structural measures. An exception to this statement worth noting will be discussed next, since it offers benefits to a significant portion of the community.

The City of Hailey’s sewage treatment facility was previously located in the area impacted by the recent flooding, adjacent to Heagle Park. While the facility was replaced by a new treatment plant in a more upland location, roughly two-thirds of the community’s sewage still flows to the old location, where a lift station is used to pump it to the new facility. This lift station is at risk of flood damage, and should be a high priority for mitigation of this risk. A flood barrier around the lift station is an obvious solution. Additionally, however, it would be worthwhile to consider elevating the access road to the lift station, since it may become necessary to power the lift station using generators (power was shut off to many areas for an extended period), in which case access to the generators would be essential (*e.g.*, refueling). Elevation of the access road could also provide some additional benefits to homes upslope by functioning as a flood barrier, but some care must be exercised in designing this to preclude impacting adjacent properties. This particular action received the greatest reception by the group, and was considered the prime candidate for future implementation.

One relatively low-impact recommendation on the list that also appeared to be well received was to construct flow restrictors, using woody debris, along the channel banks at locations where prone to overtopping and escape of river flows. While such permeable features would not contain escaping flows, they would retard the rate of escape, thereby reducing flood waters some amount and, more importantly, confining more of the river’s energy to the channel, where it could help mobilize bed materials and maintain/restore conveyance. It is anticipated that such restrictors would become more effective over time, as they trapped additional debris and sediments. These could be constructed for minimal expense, and would likely be aesthetically and ecologically acceptable on the Land trust property.

A much more costly, and complex potential action that had considerable interest would be construction of a sediment trapping feature upstream of the aggrading reach. A candidate location would be the right overbank area downstream of Bullion Street adjacent to Lions Park. (See Appendix D, Map of...
Investigation) Trapping sediments upstream of this reach would create a lean condition in the water-sediment mixture flowing downstream, promoting transport of inflowing sediment and remobilization of deposited material. Such a feature would require careful design, but has the potential to provide a longer lasting response if the aggradation in the reach is not transitory. An effective design could also incorporate other features, such as ponds or wetlands, which might be of value to the larger community. The advantage of a sediment trap lies in its ability to dictate where sediment removal occurs, where it can be relatively low-cost, as opposed to dredging in a river channel. Depending on the size distribution of trapped sediments (i.e., sand and gravel), there can be some commercial value, thereby offsetting maintenance costs. Should this option be considered further, a phased approach is recommended, with an initial feasibility assessment to examine if sufficient area is available to effectively trap an adequate volume of sediment to maintain/restore conveyance in the channel downstream and characterize performance.

Finally, it is recommended the City consider requesting a new flood study, through FEMA or USACE authorities, for example, to capture recent changes to the flood risks of the community. A risk-based analysis approach could be used to capture the uncertainties associated with the channel morphological changes noted previously. Other federal or state agencies may have authorities or capabilities to assist the community, as well. As an example, avenues for assistance from USACE could be pursued, such as under Section 22 – Planning Assistance to States Continuing Authorities Program, to further examine some of the proposed actions described above. The majority of these USACE authorities are cost shared. Contact Tatton Suter in our Boise office (208-433-4466) for further information regarding USACE authorities.
References

Brown, Carol, June 2017. Personal communication.


Boettger, Scott, June 2017. Personal communication.

USGS Gage information for 13139510, accessed June 2017.
https://waterdata.usgs.gov/nwis/inventory/?site_no=13139510&agency_cd=USGS
Appendix A.

List of Actions Taken by City of Hailey
Planning – Advance of the Flooding Event

- October 2016, all City Department heads were directed to review the City’s Emergency Operation Plan (EOP) and submit any needed updates.
  - All Department heads are entrusted to review seasonal events in the EOP (e.g. avalanches, flooding, wildfire, etc.) to be refreshed and prepared should they occur.
  - Between December 2016 and April 2017, the City staff conducted several tabletop Incident Command exercises including a flood event.
- The City acquired sandbags to protect critical City infrastructure (e.g. lift stations) prior to the May 2017 flooding event.
- In preparation for the flood event, the City acquired appropriate personal protective equipment (PPE) including personal flotation devices (PFDs), safety vests, wader boots, etc. for any staff working in the affected flood area.
- The City gave clear directives and safety guidance that all employees working in or near the affected flood areas wear PPE.
- Held Townhall Preparation Meeting in March, 2017 to prepare residents for expected flooding for the end of May / beginning of June, due to record snows.
- Article in the March edition of “Our Town” newsletter discussing flood preparations.
- Pre-flood, worked with City Engineer to identify flood water channels
- When it became apparent the 1st of May that flooding was imminent, the City held an emergency meeting for staff to prepare.
- Reviewed all employee’s vacation requests and days off (including weekends and holidays) to ensure all critical positions were filled and maintained throughout the flood event.
- On May 6, activated the City’s Emergency Operation Plan with the formulation of the Incident Command System.
- Daily an Incident Action Plan (IAP) briefing was prepared for the Team. (see attached ICS Form 201). The ICS 201 provides the Team with important information regarding the incident situation and the resources allocated to the incident. In addition to a briefing document, the ICS 201 also serves as an initial action worksheet. The Incident Command Team (ICT) organization is shown on the attached ICS 201.

During the Flooding

- Partnered with Blaine County Emergency Management and other Municipalities in the need for and the formulation of the Emergency Coordination Center (ECC).
- Partnered with Blaine County Emergency Management and other Municipalities in the need for and the formulation of the Joint Information Center (JIC).
- Held a Townhall Meeting on May 9 at the Hailey City Council Chambers for affected residents. (See attached agenda)
- Presented on May 13 at the Governor’s Townhall at the Community Campus
- Held a Townhall Meeting on May 18th at the Community Campus for affected residents. (See attached agenda)
- Preparing for a Townhall Meeting on June 8th at the Community Campus for affected resident.
**Streets**
- Identified and repaired road erosion – primarily along War Eagle Drive and Cedar Bend Drive
- Implemented road closures
- Staffed road closures during peak flows

**Water & Wastewater**
- Sandbagged around Riverside Lift Station
- Constant monitoring of wastewater flows through the Treatment Plant. Wastewater monitoring showed a sharp increase in flows through the Treatment Plant on May 15. Crews immediately investigated and found the problem (infiltration of flood waters through a pipe) and repaired within five hours
- As flood waters receded, checked every manhole cover for deposition or damage.
- Identified and repaired utility system erosion
- Regular testing of drinking water increased during the flood event
- City provided pumps and pumped out low-lying areas on the Snowfly Drive loop

**Parks**
- Park Division Manager took over duties as Volunteer Coordinator for the flood event
- Set up 5 sandbag site locations. Two sites within the Della View area; two sites at Blaine County Schools (high school and middle school) and one Partnership Site at the Maple Street/Blaine Manor (Blaine County and City of Hailey).
- Park Division Manager oversaw construction and delivery of about 50,000 sandbags to affected residents
- Heagle Park tennis court fence removed to allow for water flow and to prevent damage to the courts.
- Heagle Park – Pavilion restrooms sandbagged for protection.
- In advance of the flood, requested power was shut off to park facilities.

**Police Department**
- Routine patrolling of flood affected neighborhoods increased with road closures.
- Coordinated mandatory evacuations with County Sheriff
- Created “Residency Passes” for local neighborhood traffic only.
- Created Mandatory Evacuation Waiver to allow those residents to access and maintain the preventive measures for flooding in their homes (e.g. generators, pumps, sandbags)

**Fire & Rescue**
- Fire Chief is Incident Commander for the flood event.
- Coordinated with the American Red Cross (ARC) for the staging of shelter supplies at designated shelters in Hailey.
- Coordinated with the ARC for initial windshield damage assessments.
- Coordinated with the ECC, State, and FEMA to ensure compliance with the National
Flood Insurance Program (NFIP) requirements.

- Monitored WebEOC and provided updates for the City of Hailey as required.

City Administration

- All City staff in excess of normal hours to help with the flood emergency and keep the City running. The City continues to maintain its day-to-day operations.
- On May 8, Flood Public Information and Coordination Officers put in place
- Centralized Facebook page for “Hailey City Flood 2017 Updates”.
- Numerous news releases and media contacts
- Contacted Flood Control District #9. The City is within the Flood Control District and pay taxes to the District.
- With each peak flood, marked streets and other permanent fixtures to record the high water reach.
Appendix B.

2017 High Water Markers by City of Hailey
Appendix C.

City of Hailey Flooding Options
Appendix C. Potential Actions

**Hailey Flooding**: these are brainstormed options, many resulting from consultation with local officials, and were not initially screened for feasibility. For suggestive purposes only.

**Short Term**
- Temporary barrier or levee upstream near foot Bridge span along trail alignment (E, e)
- Dredging out channel (E)
- No action

**Long Term**
- Raising preserve trail to create permanent barrier (E)
- Dredging out channel ($, O)
- Lower grade of War Eagle Drive to create channel, create return channel at tennis court (R)
- Channelization of River – concrete lined or some other ($, E, O)
- Build a levee – tie into high ground ($, E)
- **Sediment traps downstream of Croy Creek Bridge southwest** ($, O, e?)
- Sloughs through preserve to drain out water quicker (R)
- Buy out homes in floodplain ($, E)
- **Buy out undeveloped lots** ($, E)
- Flood proofing – elevate houses, relocate mechanical equipment to higher elevation, barriers, berms or stoplogs (E, e)
- Woody debris velocity restrictors along bank line near foot bridge and Della Vista (e)
- Elevate or lower War Eagle Road near tennis courts (e, R)
- **Elevate road and barricade lift station** (E, e,) **
- Build upstream dam (E, $)
- No action

Parenthetical notes indicate the most significant expected characteristic(s) of an action.

**Key**:

$ - Substantial initial expense

E – Highly effective for flood risk management

e – Ecological acceptability

O – Significant O&M

R – Accelerates recovery
Appendix D.

Map of Significant Site Locations
SUBJECT: Technical assistance report – Flood response options for the City of Hailey, Idaho
July 7, 2017
Annex C: USACE Planning Assistance Authorities

ANNEX C: U.S. ARMY CORPS OF ENGINEERS (USACE)
PLANNING ASSISTANCE AUTHORITIES
The Corps of Engineers has several authorities that enable cooperative work to be performed with local cities, districts, tribes, and public agencies to study and/or construct projects to protect communities from future flooding or erosion, protect or restore degraded ecosystems and to promote safe and efficient navigation. These authorities allow the Corps to contribute, at least 50 percent of the study costs and 65 percent, or more, of design and construction costs.

These projects range in scope from information gathering (Planning Assistance to State) to Ecosystem Restoration (Section 206) and from Flood Damage Reduction (Section 205) to Emergency Stream Bank and Shoreline Protection (Section 14). Specific authorities are summarized below. Additional details are available upon request from the contacts at the end of this information paper.

- **Planning Assistance to States (a.k.a. Section 22 Program)** – Within personnel and funding capabilities, the USACE can cooperate with entities requesting assistance under the PAS program by providing technical assistance to support State and tribal efforts to prepare water and related land resources development plans, including watershed and ecosystem planning and help in conducting individual studies supporting the State water plan.

- **Review of Completed Projects (Section 216)** – Section 216 authorizes investigation of potential modifications to completed projects or their operation when found advisable due to significantly changed physical or economic conditions and for improving the quality of the environment in the overall public interest. Initial appraisal reports are prepared under Section 216 using operations and maintenance (O&M) funds. The cost of preparing the initial appraisal report is limited to $20,000. Results from this report can be used to support initiation of a reconnaissance study through normal budgetary process. Following the initial appraisal, the 216 study process is of the same as a normal General Investigations study.

- **Continuing Authorities Program (CAP)** – The CAP program allows the below authorities to move forward without the need to seek reviews and approvals from USACE headquarters. Each CAP program is subject to specific cost and scope limitations. Please work with USACE Planners to identify specific cost share and policy requirements for each authority (Contact information for Corps of Engineers Plan Formulators is located at the bottom of this document).

  - **Section 14** – Emergency Streambank and Shoreline Erosion Protection
  - **Section 103** – Beach Erosion and Hurricane and Storm Damage Reduction
  - **Section 107** – Navigation Improvements
  - **Section 111** – Shore Damage Prevention or Mitigation Caused by Federal Navigation Projects
  - **Section 145** – Placement of Dredged Material on Beaches
  - **Section 204** – Beneficial Uses of Dredged Material
  - **Section 205** – Flood Control
  - **Section 206** – Aquatic Ecosystem Restoration
  - **Section 208** – Snagging and Clearing for Flood Damage Reduction
  - **Section 1135** – Project Modifications for Improvement of the Environment
General Types of Projects

- **Streambank and Shoreline Erosion Protection** – The U.S. Army Corps of Engineers has the authority to protect public facilities and facilities owned by non-profit organizations that are used to provide public services, open to all on equal terms, from erosion occurring along stream banks and shorelines.

  Eligible facilities are: Highways, highway bridge approaches, public works facilities, churches, public and private non-profit hospitals, schools, and other public or non-profit facilities offering public services open to all on equal terms; and known historic properties whose significance has been demonstrated by a determination of eligibility for listing on, or actual listing on, the National Register of Historic Places.

- **Navigation** – The role of the U.S. Army Corps of Engineers, with respect to navigation, is to provide safe, reliable, and efficient waterborne transportation systems (Channels, harbors, and waterways) for movement of commerce, national security needs, and recreation.

  Types of improvements that the Corps can take on with Navigation are considered General Navigation Features (GNF). These consist of channels, jetties or breakwaters, locks and dams, basins or water areas for vessel maneuvering, turning, passing, mooring or anchoring incidental to transit of the channels and locks.

  Also included are dredged material disposal areas (except those for the inland navigation system)

  - **Snagging and Clearing** – (Section 3, River and Harbor Act of 1945). The Corps may remove trees, brush and other debris that may be determined to be obstructions to navigation or that may promote flooding. The Snagging and Clearing authority has not been provided funding for several years through Congress.

  - **Removal of Wrecks and Obstructions** – (Section 19, River and Harbor Act of 3 March 1899). The Corps may remove sunken vessels and similar objects if they are determined to be obstructions to navigation.

- **Flood Damage Reduction** – (Section 1 of the Flood Control Act of 1936)

  **Types of Improvements** – Structural Measures: Structural measures are physical modifications designed to reduce the frequency of damaging levels of flood inundation. Structural measures include: dams with reservoirs, dry dams, channelization measures, levees, walls, diversion channels, pumps, ice-control structures, and bridge modifications.

  Nonstructural Measures: They can be considered independently or in combination with structural measures. Nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use made of the floodplains, or by accommodating existing uses to the flood hazard. Examples are flood proofing, relocation of structures, flood warning and preparedness systems, and regulation of floodplain uses.

  **Single Properties**: The Corps will **NOT** participate in structural flood damage reduction for a single property. Nor will it participate in nonstructural flood damage reduction measures, unless single property protection is part of a larger plan for structural or nonstructural measures benefiting multiple owners collectively.

  Communities participating in a flood damage reduction project with the Corps of Engineers are required to participate in FEMA’s National Flood Insurance Program (NFIP) and to comply with the land use requirements of that program.
- **Ecosystem Restoration** –

Types of Improvements: A wide range of improvements to ecosystem functions is possible including, but not limited to, use of dredged material to restore wetlands, restoring floodplain function by reconnection of oxbows to the main channel, providing for more natural channel conditions including restoration of riparian vegetation, pools and riffles and adding structure, modification of obstruction so fish passage including dam removal, modifications to dams to improve dissolved oxygen levels or temperature downstream, removal of drainage structures and or levees to restore wetland hydrology, and restoring conditions conducive to native aquatic and riparian vegetation.

The objective of ecosystem restoration is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Restored ecosystems should mimic, as closely as possible, conditions which would occur in the area in the absence of human changes to the landscape and hydrology.

Indicators of success would include the presence of a large variety of native plants and animals, the ability of the area to sustain larger numbers of certain indicator species or more biologically desirable species, and the ability of the restored area to continue to function and produce the desired outputs with a minimum of continuing human intervention. Those restoration opportunities that are associated with wetlands, riparian and other floodplain and aquatic systems are most appropriate for Corps involvement.

- **Hydroelectric Power Generation** –

Types of Improvements: Hydroelectric power development may be considered during planning for multipurpose projects involving dams and lakes and may be recommended if non-Federal development would be impractical. The Corps does not construct single purpose hydroelectric power projects.

*Additions of Hydropower to Existing Projects:* Corps projects without hydroelectric power facilities may add facilities through Federal Energy Regulatory Commission (FERC) licensed non-Federal development. In rare cases, Congress may authorize Federal development. Cost of development must be borne by non-Federal sponsors.

*Pumped Storage:* Pumped storage may be considered in the formulation of water resource projects. Non-Federal sponsors are encouraged to develop pumped storage facilities determined to be feasible.

- **Recreation** – There is no general authority for Corps participation in a single purpose recreation project; but, recreation is allowed to be authorized and designed through the Corps in conjunction with other projects and authorities. The other projects have to be justified, and then Recreation can be implemented on top of the other project.

Types of Recreation Improvements: A list of recreational facilities which may be provided in recreation development at Corps projects is provided in Appendix E of Engineering Regulation 1105-2-100. As a general rule, the Corps does not participate in the development of improvement that provide outputs or services generally considered vendible. If there is no non-Federal recreation sponsor, facilities or project modifications may not be recommended unless justified by other project purposes, in which case recreation benefits are considered incidental.

- **Water Supply** – National policy regarding water supply states that the primary responsibility for water supply rests with states and local entities. The Corps may participate and cooperate in developing water supplies in connection with construction, operation and modification of Federal navigation, flood damage reduction, or multipurpose projects. Certain conditions of non-Federal participation are required.

Types of Improvements: The Corps is authorized to provide storage in multipurpose reservoirs for municipal and industrial water supply and for agriculture irrigation. Some facilities for releasing or withdrawing the stored
water can be included in the project structure. The cost of storage and associated facilities must be repaid by the non-Federal sponsor. The Secretary of the Army is authorized to make agreements with states, municipalities and non-Federal entities for right to storage in Corps reservoirs. Storage for agriculture irrigation may be provided at the request of the Secretary of the Interior.

- **Multiple Purpose Studies** – Multiple purpose studies can examine more than one type of water resources problem or opportunity and recommend projects with more than one purpose. Corps mission areas can be combined to address multiple objectives within the localized study area. For example, many existing flood control dams also supply water for M&I or agricultural uses, or provide hydropower. Additionally, there may be opportunities to address some combination of purposes which also could include ecosystem restoration and/or recreation. Oftentimes there will be competing water resources uses; therefore environmental, social, and economic considerations need to be evaluated. The evaluation process for these projects will demonstrate the trade-offs for providing various combinations and levels of economic, social, and environmental outputs. Multiple purpose studies will typically result in the recommendation of a single project or set of projects that satisfy the range of water resources purposes identified.

- **Watershed Studies** – Watershed studies are planning initiatives that have a multi-purpose and multi-objective scope and that accommodate flexibility and collaboration in the formulation and evaluation process. Possible areas of investigation for watershed study include water supply, natural resource preservation, ecosystem restoration, environmental infrastructure, recreation, navigation, flood management activities, and regional economic development. This multi-purpose approach is recommended since numerous entities within the boundaries of any watershed must agree with and support watershed improvement and management initiatives in order to successfully implement effective system-wide solutions. The outcome of a watershed study will generally be a watershed resource management plan which identifies the combination of recommended actions to be undertaken by various partners and stakeholders in order to achieve the needs and opportunities identified in the study. The watershed resources management plan may or may not identify further Corps studies or implementation projects.

For any further questions regarding Army Corps of Engineers Authority, Cost Share requirements, Federal Expenditure limits, or how to start/pursue a project with the Corps, please utilize the contact information below.

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