Planning Mentor Handbook –

A Tool for Mentors Assisting USACE Project Delivery Teams

Version 1.0

A Collaboration by the following Planning Mentors for
USACE Planning Community of Practice

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Purpose of the Planning Mentor Handbook

The concepts, tools, and techniques presented in this handbook are provided to help planning mentors better perform their role of assistance and advice to Project Delivery Teams (PDTs) in conducting risk-informed planning for USACE feasibility studies. While some mentors have received formal training in risk-informed decision-making (RIDM), others have been tapped to mentor PDTs due to their recognized experience and expertise in Civil Works water resources planning. This Handbook is intended to remind trained mentors or make those new to the mentoring role aware of various concepts, tools, and techniques available to help guide PDTs in RIDM, especially in the early phases of the iterative six-step planning process.

The need for a Mentor Handbook was identified at the Planning Mentor workshop held in Kansas City, MO in August 2019. Participants brainstormed topics that could be useful to current or new mentors, often based on their own experiences and the types of questions they frequently encountered while advising PDTs in RIDM. For each of the topics covered in the Handbook, an explanation of the meaning of the concept, tool, or technique – in a feasibility study context -- is first provided. An explanation of *what is it?* is followed by who develops it and when it should occur in the planning process. Advantages of using the concept, tool, or technique are followed by actual examples from USACE feasibility studies. In several cases references to slide decks or reports with greater detail on a given example or topic are provided. A conclusion to each topic summarizes its utility in various settings or applications.

Finally, this Handbook is intended to be a "living document," with additional topics, actual examples, or references added as they become available.

Audience

While the original audience for this Handbook was intended to be the cadre of mentors assigned to assist PDTs conducting risk-informed planning for feasibility studies, in reality all USACE planners, whether novice, journeyman, or senior, may benefit from learning about the various tools and techniques that can collectively facilitate the iterative six-step risk-informed planning process. This Handbook may therefore be viewed as a "primer" or summary of many risk-informed planning concepts, including examples and references to other sources for more detail.

Topic 1: Six Pieces of Paper

What is it? The "Six Pieces of Paper" is one of the tools to assist PDTs in "Scoping," the first task in the USACE iterative planning process. According to the *Planning Manual Part II: Risk-Informed Planning*, *"Scoping brings the purpose of the study into focus. During the scoping process, planners decide what is and is not included in the study. This determines the complexity and focus of the study. A good scope provides a road map for how the study will be accomplished. The scope of a study provides the first formulation of the risks to be managed. It is essential that the vertical team and their stakeholders agree on the scope of the planning study."*

The six pieces of paper includes:

1. A written problems and opportunities statement
2. A narrative Future Without Project Condition (FWOP) scenario
3. A list of planning objectives and constraints
4. A list of decision criteria that will lead to the choice of a course of action
5. A list of unique questions to be answered in the investigation
6. A list of the most significant uncertainties

Who develops it and when is it developed? The six pieces of paper should be developed at the very start of the study, as part of the first planning iteration which occurs ideally within the first 30 days of the study. The "six pieces" should initially be developed by USACE PDT members meeting together and brainstorming or discussing the problems, opportunities, objectives, constraints, etc., based on the knowledge they already possess about the study area. This discussion will of necessity entail the PDT making many assumptions, but identifying gaps in their data, knowledge, and understanding will serve the useful function of highlighting what uncertainties exist and where the PDT should focus their future investigations.

In terms of how this exercise may play out, a simple handout (which follows this topic) could be sent to PDT members in advance of the scoping meeting. They could fill out the form to the best of their ability based on personal knowledge, or the form could be filled out collectively during the meeting with all PDT members contributing.

Advantages. The "six pieces" form a foundation or a first scoping step providing direction to the planning process. It can also be used by the PDT to communicate (as a "read ahead" document) the study's initial scope with the non-Federal sponsor and other stakeholders at a subsequent charette. Problems, opportunities, objectives, constraints, etc., may of course be modified at the charette based on the knowledge and experience of charette participants, but the draft "six pieces" should be developed by PDT members in advance to help make the charette itself more productive, efficient and focused. Identifying key uncertainties may form the first draft of a subsequent risk register. Identifying unique questions may help the PDT anticipate future questions their decision-makers will ask.

Going further, the PDT will use the six pieces of paper developed in scoping during the next planning step, plan formulation, to complete a preliminary identification of measures or plan formulation strategies that could meet the planning objectives developed to solve the problems and realize the opportunities identified. Thinking about potential solutions may trigger additional

questions and areas where evidence gathering should be focused. Non-federal sponsors may be particularly interested in proposing their potential alternatives (which may become a Locally Preferred Plan, or LPP) during initial plan formulation. This is important information for the PDT in developing the range of alternatives, the types of effects to be evaluated, evidence gathering priorities, etc.

Examples. An example of the six pieces of paper developed by the Florida Keys Coastal Storm Risk Management study during the initial scoping (prior to charette) is attached as an example. An example of a unique question posed by the PDT from the outset included, "What are the hard constraints put on the plan formulation for the study because of the unique environment in the study area? For example, are there management measures that cannot be considered due to the presence of the National Marine Sanctuary?" An example of a significant uncertainty identified by the PDT included, "What actions will FLDOT or US Highway Administration take in the future (i.e., the FWOP) to protect or reduce potential damages to US Highway 1?"

Conclusion: In sum, developing the "six pieces of paper" helps PDTs make progress from the onset of the study. It helps PDTs document several planning steps, including identifying problems and opportunities, objectives and constraints; a narrative description of FWOP; formulating alternatives; and identifying what decision criteria will be important in plan evaluation and selection. All of this information can go into a draft "Report Summary," so it is not duplicative work. It can also help to populate a draft risk register with key uncertainties. The "six pieces of paper" helps the PDT think about and anticipate unique questions that decision-makers may pose at future milestone meetings, such as the Alternatives Milestone Meeting.

Example of Six Pieces of Paper

The following exercise was completed by the Florida Keys Coastal Storm Risk Management PDT with the non-Federal sponsor, Monroe County, FL, and other stakeholders during the study's first scoping meeting in October 2018.

1) Problems and Opportunities

Problems

1. Roadway flooding, specifically flooding of U.S. Route 1, impedes evacuation during coastal storms, thereby posing a risk to human life and safety. Flooding also causes travel delays, and prevents timely return of residents after an evacuation for a storm event.
    a. U.S. 1 is the only route from to the mainland and is thus the only evacuation route for residents and tourists in the Florida Keys.
    b. The Route 1 corridor is where all of the critical county infrastructure and development is located because it is generally the highest elevation area on each Key.
    c. Any bridge collapse due to a storm event would be catastrophic for post-storm response and recovery.
2. Flooding due to coastal storm events causes damage to structures (commercial and residential), as well as such critical infrastructure features as roadways, bridges, airports, and hospitals.
3. Habitats are being lost (and transitioning from fresher or brackish to more saline) due to coastal storms, and exacerbated by sea level rise (SLR).

Opportunities

1. Due to the rich environmental resources in the area and the surrounding Marine Sanctuary, there are various opportunities for the use of nature based features and/or restoration of the natural coastal system of defenses that are or were historically present in the study area:
    a. Mangroves—there is qualitative analysis that shows areas with established mangroves sustained less damage than areas without mangroves or in areas where mangroves have been reduced due to human activity and even performed better than areas with riprap shoreline protection structures.
    b. Coral reef

2) Narrative description of Future Without Project Condition

The study area is expected to remain vulnerable to the effects of coastal storms in the future and also experience more severe damage throughout the period of analysis due to sea level rise and increasing intensity and frequency of coastal storms due to climate change. The non-Federal sponsor has plans to complete some relatively small scale road improvement projects in areas that have been identified to be more vulnerable to sea level rise and storm damage, but does not have plans for a comprehensive coastal storm risk management effort that would

reduce damages to infrastructure and human life and safety. Projects that will be implemented by the non-Federal sponsor include:

1. $17M, 5 year roadwork plan
2. Capital improvement plan projects
3. Some Federal Highways Administration maintenance of Route 1.

3) Objectives and Constraints

Objectives

1. Reduce damages from coastal storms and coastal flooding to the natural and built environment in Monroe County over the period of analysis.
2. Reduce the risks to human life, health, and safety.
3. Reduce the vulnerability of Route 1, the primary and only evacuation route from the Keys, to the effects of coastal storms.
4. To increase the resilience of the Florida Keys to the impacts of coastal flooding. (Note: the USACE principles of resilience are Prepare, Absorb, Recover, and Adapt.)

Constraints and Considerations

Constraints:

1. There is a large amount of Federally owned land within the study area, including a National Marine Sanctuary and a Naval Air Station
2. There are a variety of unique and/or endangered species located within the study area
    a. Extensive coral reef
    b. Key deer
    c. Mangroves
3. Any project should not reduce evacuation capacity

Considerations:

1. County does not control the municipal water and wastewater infrastructure
2. The majority of the study area are protected lands, including a National Marine Sanctuary, State Parks, and some conservation easements held by NGOs
3. There are cultural/historic assets in the study area, ex. Indian Key
4. There are strict state and local codes that govern building and development within the study area, for example there is a local code that does not allow construction of riprap structures in open water within county boundaries
    a. Changing the code is possible but takes 8-12 months if it is approved

4) Decision Criteria

1. Damages prevented/reduced
2. Evacuation route protection/resilience
3. Critical infrastructure protected/damages reduced
4. Environmental impact or improvement/restoration
5. Estimated cost of measure/alternative
6. Regional Economic Development benefits/impacts
7. Resiliency (how do we measure this?) Potential metrics: improves evacuation times; improves ability of structure/ facility to absorb flood impacts; decreases time needed for recovery; “adaptability” of the measure to changing conditions.

5) Unique Questions

1. How can we economically justify natural and nature based features such as mangroves and coral reef vs. traditional measures such as hard structures for shore protection?
2. How do we plan with/around the Federal land within the study area?
3. What are the hard constraints put on the plan formulation for the study because of the unique environment in the study area? For example, are there management measures that cannot be considered due to the presence of the National Marine Sanctuary?
4. It has historically been very difficult to apply existing models to the Keys because of the unique environment, does one of the approved USACE models such as G2CRM work for this study?

6) Key Uncertainties

1. Sea Level projections, County would like us to consider the one they have been using for their own planning needs/studies.
2. Future population growth and development in the Keys – this affects the population at risk and economic assets at risk.
3. What is the expected trend for tourism in the Keys? This affects the potential population at risk and number of potential evacuees.
4. What actions will FLDOT or US Highway Administration take in the future to protect or reduce potential damages to US Highway 1?

Topic 2: Charettes

What is it? A charette (pronounced [*shuh*-ret]) is a structured, collaborative session in which a group comes together to develop a solution to a problem. It has been used in fields such as architecture, community planning, and engineering for years – bringing together a variety of different points of view to solve a difficult problem, often using the familiar six-step planning process as a key tool. The use of charettes was emphasized at the initiation of SMART Planning as a vehicle to convene the Project Delivery Team (PDT) and vertical team to make decisions critical to the study. Charettes are not required as part of Risk Informed planning, but they can be a useful tool and may provide a format for Planning Iterations or review meetings. Charettes are formal meetings with best practices that include a structured agenda (identifying the outcome/decision), facilitator, participants that include key decision makers, and read aheads to ensure preparation and common understanding. Guidance and tools for conducting a charette are available in the Planning Community Toolbox. A Charette Handbook was developed in 2013 and is available at:

https://planning.erdc.dren.mil/toolbox/library/smart/Charette%20Handbook.pdf

Who develops it and when is it developed? Ultimately, the District is the "owner" and convener of the charette and the study team is responsible for ensuring the outcomes of the charette meet the needs of the study. A charette is an opportunity to have the full PDT and all levels of the vertical team – District management, PCXs, Division and Headquarters, and non-federal sponsor – work together in a focused and intensive workshop to advance the study, share information, and make decisions. The principles of the charette process are scalable and can also be applied to planning iterations, plan formulation workshops, scoping workshops, In-Progress Reviews, and more. The structure of the charette and its outcomes will be tailored to the decisions needed by the PDT and vertical team that will advance the study.

Advantages. A charette allows the convening of the Project Delivery Team (PDT), vertical team, non-Federal sponsor and sometimes resource agencies or other stakeholders to make decisions critical to the study. A charette has the potential to save the study team and vertical team time and money as it may enable more effective and efficient communications and review of study products. The organized approach with read aheads (e.g., risk register, decision management plan, report summary, six pieces of paper, etc.), detailed agenda, clearly defined participants (including facilitator, support team, and decision makers), and focus on delivering a decision or recommendation can be useful in assisting a PDT to get decisions and "buy in" on the process and outcomes.

Examples. Charettes can be used as a format for one or more of the Planning Iterations to gain vertical team buy-in on decisions related to key uncertainties, data/analysis to gather prior to next milestone, and decisions on screening of alternatives, etc. A charette can also be used as a way to fully explore the problems and options surrounding a potential need for rescoping to maintain 3x3x3 parameters or the need for an exemption to get all levels of the vertical team on board with the risks, need, options, and rationale for any modifications.

Wondering how a charette actually plays out? In addition to the Charette Handbook cited above, attached here is another example. This detailed agenda was for a virtual scoping charette, which took place over six sessions between April 21-23, 28, and May 5-6, 2020, is provided courtesy of the Yorkinut Slough Habitat Rehabilitation and Enhancement Project PDT (CEMVD-RPEDN). Virtual charettes have recently become more common, due to both health-

related travel restrictions, as well as overall savings by reducing travel costs for in-person charettes. In addition to the agenda, the Yorkinut PDT provided a summary of the *Virtual Charette Tools used in the Yorkinut Slough HREP Virtual Scoping Charette, April-May 2020,* also attached here. The virtual tools covered include such lessons learned as 1) dry run of all technology; 2) sending read ahead materials; 3) Webex linked to audio; 4) separate facilitator, note-taker-timekeeper, and Webex manager; 5) logging in early; 6) sharing files; 7) setting ground rules using Poll Everywhere; 8) interactive maps; and 9) virtual site visits, among many others tips. Points of contact for the charette are also listed in the *Virtual Charette Tool* document.


Yorkinut Charrette FACILITATOR Agenda


Virtual Charrette Tools - Yorkinut Scopi

Conclusion: Charettes are not a required tool for risk informed planning, but they can be a valuable tool to organize an iteration, gain vertical team alignment on key planning issues, and advance to group decisions. It should be mentioned that some studies and PDTs have recently conducted less formal, smaller scale “study kickoff” meetings intended to cost less but still provide the basic functions of a charette for going through the initial iteration of the planning steps with brainstorming involving USACE, the non-Federal sponsor, and potentially resource agencies. In other cases these kick-off meetings are precursors to more formal charettes, whether in-person or virtual, which may include more participants and follow the more structured format described above. In either case, PDTs can use informal kick-off meetings and formal charettes as a way to reach decisions throughout the study process.

Topic 3: Engagement Techniques

What is it? What is the best way for planning mentors and the PDTs they mentor to "connect" or engage? How can mentors be more effective in opening and maintaining dialogues with their PDTs? Because the experience of planning mentor interactions with PDTs has varied greatly (e.g., the frequency, value, and ease of those interactions), the intent of this section is to suggest engagement techniques that have been successfully employed by mentors. Several engagement techniques are summarized below.

1) Mentor calls in to PDT meetings. Whether on a regular or subject-specific basis, by virtually participating via WebEx or using a call-in option for PDT meetings the mentor will gain familiarity with the feasibility study and the PDT will be able to ask questions or seek the mentor's advice during the call.

2) Product-oriented meetings. The mentor may lead the PDT through a meeting (in person or virtual) and facilitate development of a product, such as the Six Pieces of Paper, a Risk Register, or even a Rapid Iteration of the planning process by the end of the meeting. Focusing on a product can give structure to the mentor/PDT relationship and advance the study process simultaneously.

3) Develop "cheat sheets"/ checklists/ "strawmen" prior to a meeting that provide visualization. The mentor can provide a blank or partially filled out Six Pieces of Paper, Risk Register, or a checklist of plan formulation strategies, for example, in advance of a meeting with the PDT to initiate discussion on a given topic and to help the PDT visualize what the products look like or how they can be used. This can help the PDT think about the process or issues in advance of the meeting and lead to getting more accomplished during the actual mentor-PDT meeting.

4) Best practices to encourage dialogue from all. The idea here is to avoid one or a few people dominating discussions at meetings by asking all PDT members to participate round robin style, or to ask for all participants to provide written responses on index cards so that all voices/ ideas may be considered. Another technique is to queue up a discussion topic and ask participants to bring their ideas to the next meeting. This allows team members that like to take their time to gather their thoughts before sharing with the group the opportunity to participate at a pace they are more comfortable with.

5) Use a "tech talk" to describe something of interest to the full PDT. The mentor may develop and deliver a presentation or mini-webinar on a given topic of utility and interest to the PDT. This has the benefit of getting the entire PDT up to speed on a given topic (e.g., what is risk-informed planning? What is a risk register and how is it used? What are conceptual models and how can they help in risk identification?). In each case the tech talk could precede the mentor facilitating a rapid iteration of the planning process or an exercise in which the risk register or the conceptual model is developed collectively be the PDT. Other PDT members could also be asked to lead tech talks, such as how the engineering team developed fragility curves, which can then provide the mentor an opportunity to help the PDT consider and document risk and uncertainty associated with that topic.

6) Charters. When the Planning Mentor Program first kicked off in 2017, formal, signed "charters" were suggested to define the mentor's role vis-à-vis the PDT. A sample template of the agreement between a mentor and his/her PDT is provided below. Charters are not required, but can be useful in establishing the overall objectives for the mentor, delineating roles and responsibilities for the mentor and PDT, specifying resources and support, and establishing general standard operating procedures, such as frequency of communication, schedule of regular teleconferences, etc.

DRAFT_Planning Mentor Charter Agree

Who develops it and when is it developed? Although either party may initiate the engagement, the role of the mentor is to encourage and assist the PDT in the concepts, practices, and application of risk-informed planning. The mentor therefore needs to take an active role in reaching out to the PDT, in letting the PDT know of his/her availability, and in seeking ways for their collaboration to be most beneficial to the PDT. In other words, the PDT may not know what to ask from their mentor, so the mentor should be proactive in offering various ways to help.

Advantages. The mentor can be more effective in communicating with the PDT and disseminating the concepts of risk-informed planning by adopting several of these engagement techniques. The mentor can help the PDT utilize the expertise and experience of the planning mentor to engage with them in a meaningful way.

Examples. The attached presentation was used by a mentor to introduce the concepts of risk informed decision-making and the risk register. The attached risk register "cheat sheet" was developed by the same mentor to explain the content and use of the Risk Register to PDTs (e.g., how to fill it out, what the columns mean, how to think about things as risks — not just, "we don't have all the info/details we need") and serves as a reference as the PDT fills out the risk register.

Intro Risk Informed Decision Making.pdf

Risk Register cheat sheet.docx

Conclusion: PDTs can often benefit from mentoring in risk-informed planning, but they may not know what to ask for. It may therefore be up to the planning mentor assigned to a PDT to initiate dialogue and "meet the PDT where they are" in the planning process, offering a variety of areas of expertise, techniques, and tools to help advance the study. Several engagement techniques, described above, have been successfully employed by mentors. More examples will be added as they are developed.

Topic 4: Rapid Iteration(s)

What is it? Rapid iteration(s) are a quick and intentional cycle **through all steps** of the Planning Process (see Figure 1) and repeated throughout the study process. A rapid iteration is completely faithful to the USACE six-step planning process and a critical aspect of risk-informed planning.

- An iterative process is one that is repeated as needed. Any portion of the process can be iterated, and the iteration can include the entire planning process, just a single step in the process, or a subset of the steps.
- With each iteration planners attempt to reduce uncertainty of the planning process. Iterations repeat, elaborate, refine, correct, or complete a part of the planning process.
- The primary reason the planning process is iterative is to address uncertainty. Uncertainty can increase or decrease with new information; you learn as you plan. As more information becomes available, your understanding improves, and it is often necessary to go back over something to make it better.

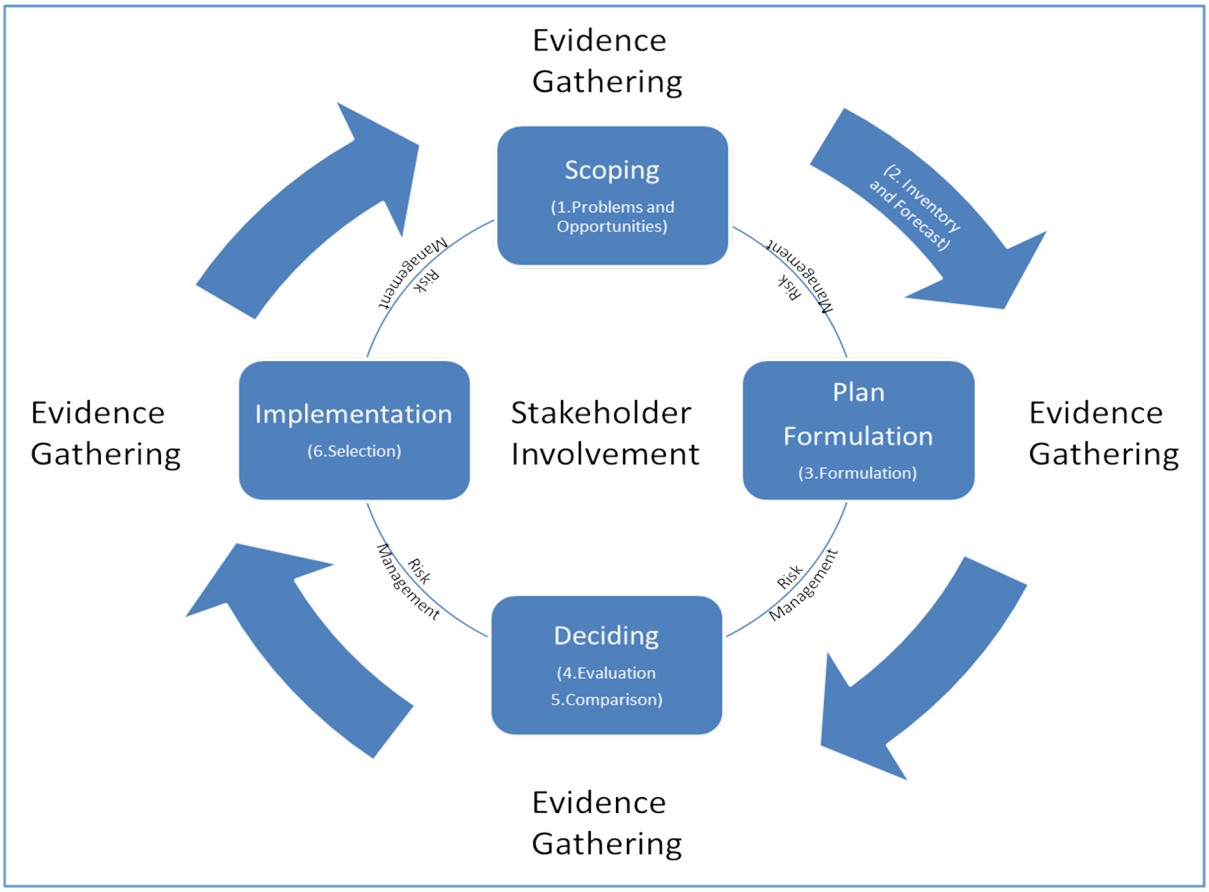

Figure 1. Risk-Informed Planning

Who develops it and when is it developed? Rapid iterations can be carried out with any number of PDT members and participants from the vertical team, sponsors, stakeholders, and/or public. However, ideally it includes at least the key, core multi-disciplinary team members. A key aspect of rapid iterations is that they occur throughout the study process

continuously refining the study scope, reducing and clarifying risk and uncertainties. The *Planning Manual Part II* prescribes at least three iterations in detail, followed by as many additional iterations as necessary to arrive at the best plan (see Figure 2).

- **1st iteration** – At the beginning of the scoping phase (first 30 days), document the information the team knows at that time and the information that is needed to be gathered to inform the Alternatives Milestone decision.
- **2nd iteration** – During the scoping phase, conduct a second iteration (first 90-100 days) prior to the Alternatives milestone (AMM) with information gathered to identify the needs identified from the first iteration; primarily existing available information.
- **3rd iteration** – During the alternatives evaluation phase (within 1 year) and prior to the Tentatively Selected Plan (TSP) milestone, develop the quantitative information necessary to compare the alternatives and select a TSP.
- **Additional iterations** – After TSP identification, there are iterations of individual steps or tasks, but not necessarily an iteration of the entire planning process. During the feasibility analysis phase, develop information needed to optimize the recommended plan, certify costs, and reduce instrumental risks to acceptable levels.

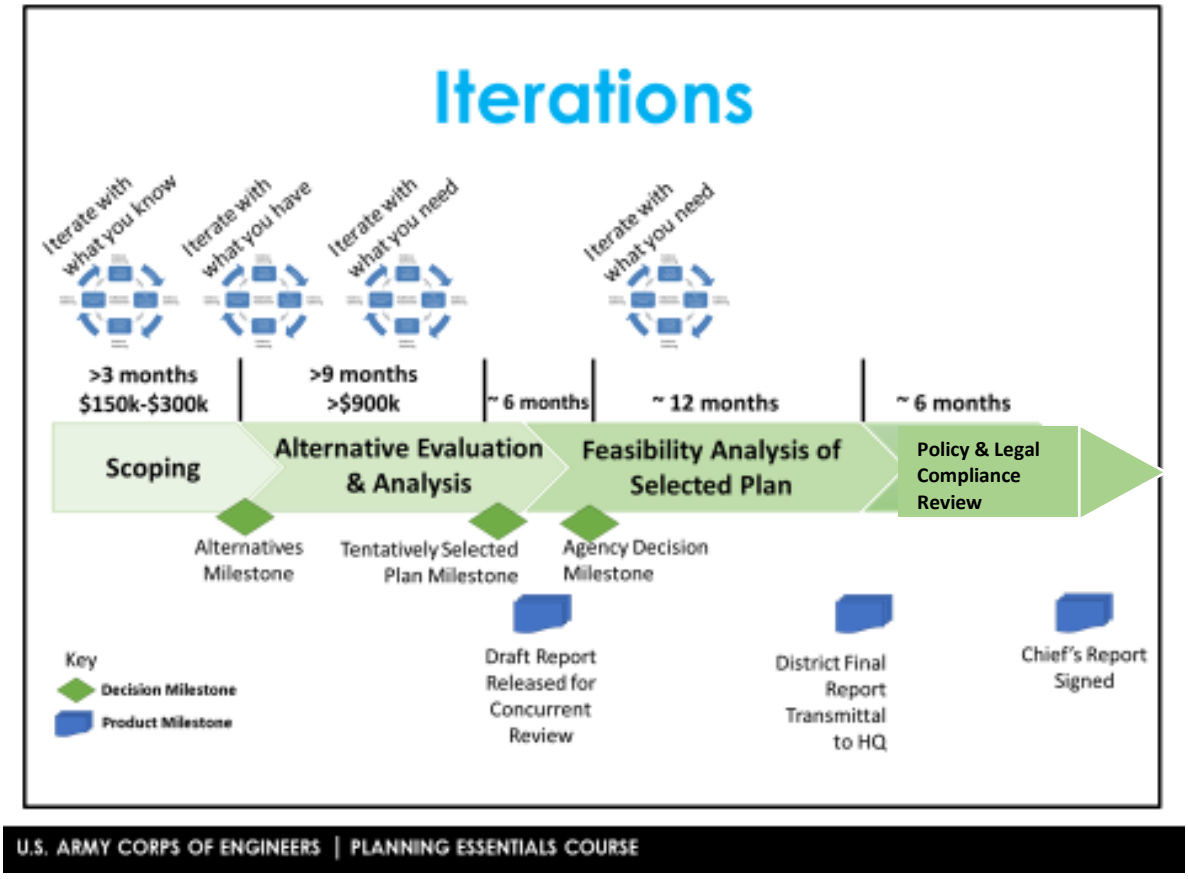

Figure 2. Rapid Iterations throughout the Planning Process

Advantages. Rapid iterations actively move the study forward by focusing on what data/analyses are needed to reduce uncertainty and make a decision. It encourages critical thinking and asking questions: Can we make a decision with what we know now? What risks would we face if we make decisions with what we know now? Do we need to address that risk now? Later? Iterations of the planning process can be used to reduce uncertainty strategically throughout the process and to gather data at the optimal time to make the next decision. This helps to keep the study moving forward and effectively and efficiently investing limited funds and time.

Examples. One example of how to use the rapid iterations is to conduct a rapid iteration of the planning process using the six sheets of paper as part of the initial internal PDT kick-off meeting. Use the notes from that iteration to conduct a follow on more refined first iteration with the sponsor and vertical team, other stakeholders, etc. An example of a presentation delivered by a mentor in the first few months of the Los Angeles County Flood Risk Management Study to explain risk-informed planning and initiate a rapid iteration of the planning process with the PDT is attached here.

LACFCS Workshop 16 April 2019.pdf

Conclusion: Multiple iterations of a risk-informed planning process focuses the team and decision makers on the additional information, data, and analyses necessary to reduce uncertainty and/or manage either study or project risk. It proactively moves the study forward, encourages critical thinking, provides a mechanism to strategically manage uncertainty, assists in gathering data at the optimal time to make the next decision, and allows teams to most effectively and efficiently invest limited funding and time.

Topic 5: Plan Formulation Strategies

What is it? Planning can be defined as the deliberate organizational activity of developing an optimal strategy for solving problems and realizing opportunities in ways that achieve a desired set of objectives. It is a systematic way of combining measures into alternative plans based on a selected theme or focus. Using formulation strategies to guide and organize the creation of alternative plans is a sound method for logically progressing through the study process. Strategies can be employed to help group or combine measures, identify different ways to solve problems, and enable a rational, transparent process to more quickly develop an initial array of distinctly different alternatives. Strategies can take many forms limited only by the team's creativity. According to the *Planning Manual Part II (Sec. 8.5)*, "a formulation strategy is a disciplined way to produce one or more specific plans."

Who develops it and when is it developed? Plan formulation is an ongoing creative group activity and plan formulation strategies are very helpful for identifying the Tentatively Selected Plan. Anyone on the Project Delivery Team (PDT) can play a role in developing formulation strategies; in fact, this is encouraged as different perspectives allow for different methods for addressing study objectives. The PDT can also solicit input from the public, stakeholders, or the sponsor. Strategies can be employed as early in the study as when management measures are developed and are carried through to guide alternative development and comparison. It is critical to document the basis for the strategy along the way, to define why it is proposed as a framework for alternative development, and what it will achieve towards addressing objectives. Planning typically is not a straight-forward, linear process, and new strategies can be developed as the PDT acquires more information or learns that certain measures or alternatives may not be effective.

Advantages. Using strategies to guide and organize the formulation of alternative plans can greatly improve the effectiveness of alternative comparison and evaluation. One of the biggest advantages for employing strategies is they help to create truly unique and independent alternatives. For example, considering flood risk management (FRM) from a nonstructural, detention basin, or levee perspective allows for a wide array of significantly different approaches to be considered. Besides organizing strategies around general types of measures, such as the previous example, strategies may be based on achieving different planning objectives or solving problems in different geographic areas. Using FRM again, strategies could be based on meeting certain objectives, like reducing risk to human health and safety, reducing property damage, and reducing risk to critical infrastructure; or geographically, such as reducing risk only to high damage or population centers, or reducing risk to the entire study area. An added benefit of employing strategies is the ability to more effectively convey information to the public and decision makers. Strategies are descriptively named and are more readily identifiable than the typically used alpha or numeric nomenclatures (such as Plan A4, etc.).

Examples. Strategies can originate from any number of sources including prior reports, the general public, conceptual models, stakeholder preference, or decision support tools. "A strategy usually consists of a set of tactics or approaches that shape and guide plan development; thus, strategies structure the *how to* of plan formulation[1]." Examples of plan formulation strategies may include but are not limited to the following:

- Maximize Environmental Outputs
- Ideal Scenario
- All Possible Combinations
- Something for Everyone
- Locally Preferred
- Nonstructural
- Cornerstone/Base Plan Strategy
- Resource Agency Preference

Two webinars offering examples of plan formulation strategies were presented to the PCoP in April and September 2016, respectively, for 1) all business lines (https://planning.erdc.dren.mil/toolbox/webinars/16Apr7-PlanFormStrategies.pdf); and 2) specifically for aquatic ecosystem restoration projects (https://planning.erdc.dren.mil/toolbox/webinars/16Aug26-EcoPlanFormStrategies.pdf).

Conclusion: Utilizing plan formulation strategies is the surest method for rationally and deliberately collecting management measures into distinct alternative plans. Strategies help ensure alternatives are designed to achieve objectives and they help identify distinctly different approaches towards solving study area problems. Plan formulation strategies should be provided to VT members at the Alternatives Milestone to document and demonstrate the various paths undertaken by the PDT to arrive at the focused array of alternative plans.

Topic 6: Screening Techniques & Criteria

What is it? Criteria are the attributes, variables, and values associated with a decision problem that are important to decision makers. A criterion is something the decision makers care about and something that can influence the decision makers' choice. You should expect the screening/decision criteria for a USACE planning study to reflect the study's planning objectives and constraints. For example, if one of a study's planning objectives is to reduce flood risk in the study area, then a criterion related to measuring flood risk, such as the economic value of flood damages, will very likely be an important screening/decision criterion for that study. Criteria may vary from decision-to-decision and between milestone meetings during the planning process.

The *Planning Manual Part II* mentions benefits, costs, and environmental impacts of each plan as decision criteria that will almost always come into play for every USACE study. In addition, the four formulation and evaluation criteria of effectiveness, efficiency, acceptability, and completeness that are specified in the *Principles & Guidelines* (P&G Paragraph 1.6.2(c)) should be considered in the screening, evaluation, and comparison of alternative plans. Alternatives considered in any planning study should meet minimum subjective standards of these criteria in order to qualify for consideration and comparison with other plans.

Decision criteria are needed for the following key decision categories: scoping the study; management measures screening; evaluation of alternatives; comparison of alternatives; and selection of the TSP.

Who develops it and when is it developed? One of the key tasks in any planning study and a significant component of your plan formulation strategy is to determine the appropriate screening/decision criteria that will be used at different points throughout the study to help the PDT eventually arrive at a TSP for recommendation. For this to be effective, the screening/decision criteria need to tie back to the study objectives and be developed early in the study process, preferably during scoping and in concert with establishing the Problems, Opportunities, Objectives, and Constraints. In fact, the PDT's identification of decision criteria for the study is one of the initial scoping tasks as part of the Six Pieces of Paper. It's important to identify decision criteria early to help the PDT determine what information or data *may already be available* to screen and evaluate alternatives, as well as what information, data, or analysis *will need to be collected and undertaken in the future* to screen and evaluate alternatives.

Can the decision criteria change throughout the course of the planning study? Yes. Generally decision criteria become more specific and quantitative as the study progresses, even when the criteria are evaluating the same attribute of an alternative plan. For example, a criterion related to ecosystem output for an AER project may progress from a subjective judgment that an alternative will yield a "positive, large" increase in wetland habitat at the management measure screening phase of the planning process; to an estimate of 2,500 intertidal marsh acres improved/ restored for that alternative during the deciding phase of the planning process; to an estimate of 1,780 habitat units using the Combined Habitat Assessment Protocol (CHAP) model for the same alternative at the stage of planning process when the TSP is identified.

Example #1. Let's take a hypothetical multi-objective AER/FRM planning study and show what screening/decision criteria might be employed and how they might be measured. The very

simple conceptual model in Figure 3 below shows a river that is experiencing severe erosion and stream incision. In this example, aquatic and riparian habitat are degrading as a result of excessive erosion, which impacts water quality, and damages, by siltation, the structure of the benthic or bottom habitats. There is a loss of lateral connectivity between the stream and its floodplain (i.e., as the stream incises and deepens, it literally leaves its floodplain behind, or "strands" it, leading to loss of native riparian vegetation potentially impacting both riparian and other aquatic species). Our problem statement for this conceptual model might read: "Urbanization and other watershed alterations are changing the hydrology and hydraulics of Dry Creek, causing downstream channel incision, stream bank erosion and bluff failure, which in turn are causing: loss of natural riparian and floodplain vegetation; increased erosion and sedimentation of downstream habitats, leading to poor quality habitat for resident and migratory fish; increased risk of damages to nearby residential structures and critical infrastructure; and increased risk to public health and safety from collapse of structures and loss of functionality of a water treatment plant." Conceptual models have utility in portraying cause and effect relationships, which can help us identify the criteria important for decision-making.

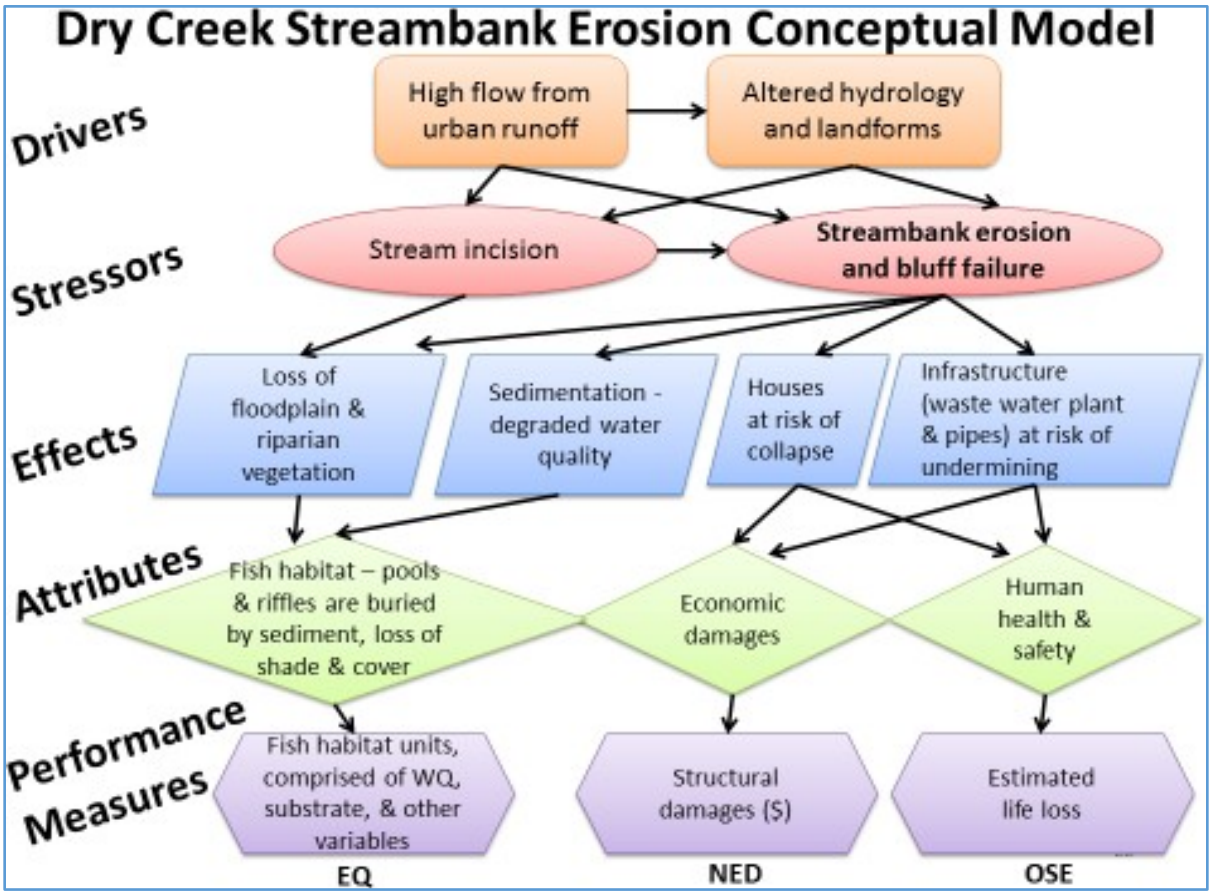

Figure 3. Hypothetical Conceptual Model as Basis for Screening/Decision Criteria

Going beyond the problem statement, our ecosystem-related planning objectives for this hypothetical study (we could also have flood risk management-related objectives) might focus on restoring both 1) the quality and quantity of degraded aquatic and riparian habitat; and 2) riverine-floodplain connectivity in the Dry Creek watershed over the period of analysis. Our management measures would be formulated to meet these objectives, and we might measure

the effectiveness of our management measures or combinations of measures (i.e., alternatives) at the *evaluation/deciding step of the planning process* through their **predicted changes to such decision criteria as aquatic and riparian habitat units** (indicator species could be selected for each habitat type) using a certified or approved ecological model. Similarly, at the *evaluation/deciding step of the planning process* our alternatives might be evaluated for their effectiveness at reducing a flood risk objective through such decision criteria as either a **reduction in economic flood damages** or a **reduction in lives lost**, calculated using such certified models for NED and OSE benefits, respectively, as HEC-FDA and LifeSim. These decision criteria used at the *evaluation/deciding step of the planning process* (i.e., aquatic and riparian habitat units, economic damages prevented, and life loss) are labeled performance measures in the conceptual model diagram above.

Example #2. In the hypothetical Dry Creek study described above, the decision criteria were used to evaluate the effectiveness of alternatives, i.e., how well alternatives meet the planning objectives. But the metrics themselves (aquatic and riparian habitat units, economic damages prevented, and life loss) would likely not be available or developed until enough information had been collected and analytical models run during the evaluation/deciding step of the planning process. These metrics would likely be important decision criteria in TSP identification, along with such criteria as **costs, environmental impacts, acceptability**, and **completeness**.

But do we need such specificity in measuring the effectiveness of alternatives earlier in the planning process, say in the screening of management measures? The answer is "no." We can still use "effectiveness" as a screening criterion earlier in the planning process, based on the professional judgment and experience of the PDT. We might measure effectiveness more qualitatively through such metrics as using color coding (green/amber/red), assigning nominal value (+, 0, -), using a numeric system, or even simply a "yes/no."

When brainstorming management measures at a planning charette or at some point early in the planning process, our initial goal is creativity, to make sure we leave "no stone unturned" – what solutions could possibly solve the problems at hand? To make sense of the many management measures we might develop, however, we need to screen them to a manageable and realistic subset. One obvious screening criterion is effectiveness – will the management measure under consideration help achieve, and to what extent, a given planning objective? Early in the planning process, this evaluation of effectiveness may be qualitative – will a management measure a) highly, b) moderately, c) slightly, or d) not at all contribute to the achievement of a planning objective (and with what degree of confidence)? Later in the planning process, when we are evaluating alternatives, we are still very much concerned about effectiveness (along with costs, other impacts, resilience, etc.), but we will measure effectiveness quantitatively through, for example, such metrics as habitat units and biotic integrity. Whether qualitative or quantitative, our report documentation should include a table that shows, for each restoration management measure, which objective is likely to be addressed and how completely the measure is likely to address the objective. Figure 4 shows a simple example table using management measures developed for our "Dry Creek" conceptual model. Green cells denote a management measure highly contributes to the achievement of a planning objective. Similarly, yellow cells denote moderate contributions, amber cells denote slight contributions, and red cells denote no contribution to the achievement of a planning objective. Figure 4 below can also be used to show the results from screening management measures; i.e., whether measures are retained or dropped (in this example, based on their contributions to planning objectives). The PDT may decide to drop the management measure "place cobble/gravel instream" in Figure 4 from further consideration because of its lack of effectiveness in meeting most of the planning objectives.

Management Measures	Ability to Achieve Planning Objectives (Effectiveness)			
	Objective: Increase/Restore Aquatic Habitat	**Objective: Increase/Restore Riparian Habitat**	**Objective: Increase River/ Floodplain Connectivity**	**Objective: Reduce Damages to Water Treatment Plant**
Instream grade control structures	High	High	High	High/Moderate
High flow detention ponds	Moderate	Moderate	Moderate	Moderate
Terrace banks	Moderate	High	High	Low
Place cobble/ gravel instream	Low	None	None	None
Place armor/ rip rap on banks	Low	Low	None	High
Plant native vegetation on banks	High	High	Moderate	Moderate

Figure 4. Effectiveness as Screening Criterion (Using Color-Coding) for Dry Creek Management Measures

Example #3: In the following example from the Lower Santa Cruz River, Arizona, FRM Feasibility Study, the PDT used the four P&G criteria to evaluate and screen various management measures during early plan formulation using a score of 1-3, with "3" meaning the criterion would be fully met, "2" indicating the criterion would be partially met, and "1" indicating the criterion would not be met. Due to the limited ability to generate new data prior to the Alternatives Milestone, scores for each criterion relied principally upon existing data and professional judgment.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities (P&G Section VI.1.6.2(c) (2)). Measures or alternative plans that clearly make little or no contribution to the planning objectives should be dropped from consideration. Measures were scored for effectiveness based on the following:

3: The measure fully meets the objective(s).
2: The measure partially meets the objective(s).
1: The measure does not meet the objective(s).

Efficiency is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment (P&G Section VI.1.6.2(c)(3)). Benefits can be both monetary and non-monetary. Measures or alternative plans that provided little benefit relative to cost should be dropped from consideration. Measures were scored for efficiency based on the following:

3: The measure provides the most benefits for the least cost or provides desirable benefits (outputs that meet several objectives) for similar costs to measures that provide more limited benefits (outputs that meet only a few objectives).

2: The measure provides benefits that meet one or more objectives but these benefits are more limited or more expensive than other similar measures.

1: The measure is costly and provides minimal output.

Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies (P&G Section VI.1.6.2(c)(4). Acceptability means a measure or plan is technically, environmentally, economically, and socially feasible. However, the PDT separated the Acceptability criterion into two dimensions to reflect both a) implementability (whether the plan is technically, environmentally, and economically feasible) and b) satisfaction (whether the plan is feasible or may pose a major "roadblock" from the perspectives of key stakeholders such as the non-Federal sponsor, resource agencies, and the general public). Measures were scored for these two dimensions of acceptability based on the following:

Implementability:

3: Easy to implement
2: There would be some institutional barriers to implementing the measure (e.g., the measure would require additional agency permissions or permits).
1: There are legal barriers to implementing the measure.

Satisfaction:

3: The measure is largely acceptable to all stakeholders.
2: There would be some political barriers to implementing the measure.
1: The measure would likely be totally unacceptable to major stakeholders.

Completeness is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of a plan are dependent upon the actions of others. Completeness was not evaluated at this stage of the planning process (screening of management measures) because even if measures are not deemed complete individually, they may be subsequently combined with other measures to form alternatives that do meet planning objectives.

In this study, the scoring results were compiled and averaged. After scoring, the PDT reviewed the results and confirmed that the highest scoring measures should be retained. The lower scoring measures were reviewed further, and some were indeed screened out. Results of this screening were documented in the feasibility report.

Conclusion. A criterion is something decision makers care about and something that can influence the decision makers' choice. You should expect the screening/decision criteria for a Corps planning study to reflect the study's planning objectives and constraints. Criteria may vary from decision-to-decision and between milestone meetings during the planning process. Likewise, it is expected that the same criterion, for example "effectiveness," may be measured differently (qualitatively and quantitatively) throughout the planning process, with detail, specificity, and certainty increasing as the study progresses. While quantitative, objective decision criteria should be used for TSP selection and feasibility level optimization of the TSP, scoring metrics as simple as color-coding, H/M/L, numeric scoring, and yes/no may be acceptable for screening and initial evaluations. Another best practice is to use spreadsheets to keep track of the decision criteria used and how they were measured throughout the planning

process. This record can then be included in summary or in detail as appropriate in the feasibility report or in a plan formulation appendix.

Topic 7: Level of Detail Needed Throughout the Planning Process

What is it? The *Planning Manual Part II: Risk-Informed Planning* stresses the importance of collecting the appropriate level of detail to make the decision at hand while considering the risk of not gathering additional information. The greatest challenge is balancing the time, effort, and expense of gathering more evidence to reduce uncertainty versus the risk of making a poor decision. This section provides examples for Planning Mentors to use in assisting teams with determining the appropriate level of detail necessary throughout the planning process.

Who develops it and when is it developed? As explained under Topic 4, rapid iterations are an essential process to enable risk-informed planning. Iterations of the planning process can be used to reduce uncertainty strategically throughout the process to gather data at the optimal time to make the next decision. Ideally, each iteration includes at least the key multi-disciplinary PDT members. Members from each discipline make the determination whether they have enough information available to make the next decision at that stage of the planning process (or iteration). Each iteration will include progressively higher levels of detail.

- **1st iteration** – at the beginning of the scoping phase (first 30 days), document the information the team knows at that time and the information that needs to be gathered
- **2nd iteration** – during the scoping phase (first 90-100 days), conduct a second iteration with information gathered prior to the AMM and to inform the Alternatives milestone decision
- **3rd iteration** – during the alternatives evaluation phase (within 1 year), develop the quantitative information necessary to compare the alternatives and select a TSP
- **4th iteration** – during the feasibility analysis phase, develop information needed to optimize the recommended plan, certify costs, and reduce instrumental risks to acceptable level

Advantages. During each iteration, the PDT should focus on reducing *instrumental uncertainties.* Instrumental uncertainty refers to things that could affect the decision. *Relevant uncertainty* refers to things people may care about but things that will not change the decision. While reducing relevant uncertainties can *feel* essential, focusing on reducing those instrumental uncertainties that can or will affect the next planning decision is a critical component of getting the right information at the right time and eliminating collection of data that is unnecessary. Note that Figure 5 below refers to “constraints” but these refer primarily to budget and schedule constraints as opposed to planning constraints.

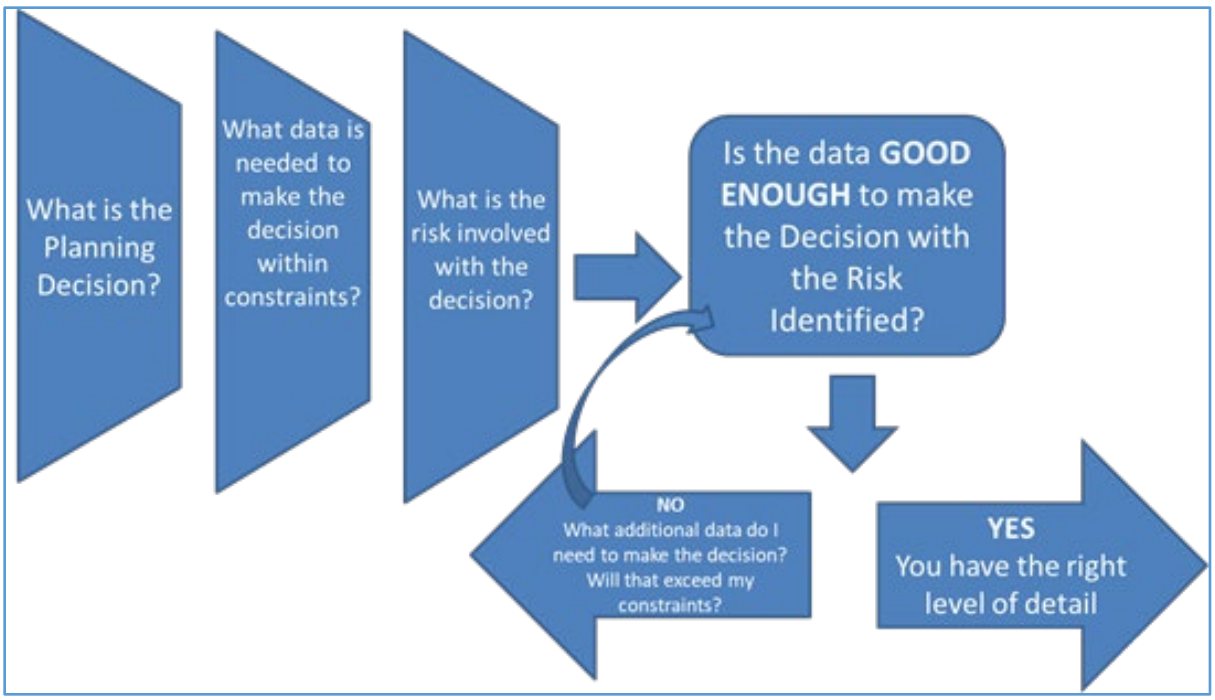

Figure 5. Risk-Informed Approach to Answering Level of Detail

Examples. Table 1 below offers examples of the appropriate level of detail necessary throughout the planning iterations for all studies in general and by select business lines.

Table 1. Examples of Level of Detail throughout Planning Iterations

Steps	Scoping	Alternative Evaluation & Analysis	Feasibility Analysis of Selected Plan
General	Qualitative data/ high uncertainty. Existing Information. General descriptions of measures/ alternatives, qualitative estimate of benefit (H, M, and L), order of magnitude cost estimates.	Quantitative data/ medium uncertainty. New information gathered. Conceptual level design, comparable analysis of benefits amongst alternatives, level 1 or 2 cost estimates, rough estimate of real estate costs.	Quantitative data/ low uncertainty. Higher level of detail for information. Feasibility (~10-30%) level design, optimized NED benefits, level 3 cost estimate to support certification; real estate cost estimate or appraisal as appropriate.
Examples	**Scoping**	**Alternative Evaluation & Analysis**	**Feasibility Analysis of Selected Plan**
Flood Risk Management	Existing maps, info on flooding, trends, census/ HAZUS data, levee safety. General categories of measures to be included (levees, floodwalls, detention basins, non-structural, nature-based) evaluated using qualitative screenings.	H&H info, structure inventories, geotech info, wetland/habitat surveys. Site-specific footprint of measures with conceptual design and assumptions related to size of structure that may be appropriate; evaluated using HEC-RAS and HEC-FDA. If low benefits are a concern, consider modeling max potential benefits and screening alternatives based on parametric cost estimates. Identify potential mitigation needs and costs of alts.	Detailed analysis of Recommended Plan (RP) to include multiple heights/sizes of structures in the RP in order to optimize NED benefits. Conduct life safety analysis of RP. Model habitat losses and mitigation options for optimized plan using eco models and CE/ICA.
Coastal Storm Risk Management	Existing coastal storm / storm surge / flooding hazard maps, records of coastal storms, sea level rise trends and projections, census / HAZUS data, records of shoreline movement and beach/dune erosion. General categories of measures to be included (beach nourishment, dune restoration, seawalls, jetties, shoreline stabilization, non-structural, nature-based) evaluated using qualitative screenings and combined into alternatives	Model inputs (meteorological data, coastal morphology, economic data, emergency management practices, etc.). Site-specific footprint of measures with conceptual design and assumptions related to size, length, width, and height of structure that may be appropriate; evaluated using Beach-FX or other appropriate software. If low benefits are a concern, consider modeling max potential benefits and screening alternatives based on parametric cost estimates. Identify potential mitigation needs and costs of alts.	Detailed analysis of Recommended Plan to include multiple heights of structures in the RP in order to optimize NED benefits. Conduct life safety analysis of RP. Model habitat losses and mitigation options for optimized plan using eco models and CE/ICA.

Ecosystem Restoration	Existing maps, info on species and habitats of concern, trends. General categories of measures to be included (wetlands, in-stream habitat, fish passage) evaluated using qualitative screenings.	H&H info, habitat surveys, information to feed eco model(s). Site-specific footprint of measures with conceptual design and assumptions related to size of features, eco modeling completed and CE/ICA conducted. Consider potential high-level adaptive management (AM) needs along with parametric costs. If AM vastly different amongst alternatives, include in analysis.	Detailed analysis of Recommended Plan to include specific alignment of features. Develop detailed monitoring and adaptive management plan and include costs in certified cost estimate.
Deep Draft/ Inland Navigation	Existing vessel traffic and commodity forecasts, information on species of concern, potential dredged material disposal sites. General categories of measures to be included (deepening, widening, lengthening, training walls, expansion/replacement of lock chambers, non-structural) evaluated using qualitative screenings and combined into alternatives.	Develop vessel traffic and commodity forecasts. Conduct sediment sampling and habitat/ species surveys. Specific footprint of measures and multiple depths/ widths analyzed as appropriate. Assumed quantities and disposal locations based on initial sampling results.	Feasibility level ship simulation of recommended plan to address safety concerns and inform design. Refined quantity estimates. Optimized depths/ widths/ lengths as appropriate.

Conclusion. Determining the appropriate level of detail at any given point in the planning process is often one of the most challenging questions for many PDT members to address. While having more information generally reduces uncertainty and gives planners and other PDT members greater confidence in their decisions, reducing that uncertainty usually comes with associated study costs in terms of time, effort, and expense. Focusing only on instrumental uncertainties (i.e., that can affect the decision at that stage or iteration of the planning process) can help PDTs strike that balance. Rather than collecting all the information that will eventually be needed upfront, PDTs should focus on reducing the instrumental uncertainties during each iteration.

Topic 8: Examples of Risk Informed Decision Making for Different Business Lines

What is it? Risk-informed planning is basically the marriage of the USACE traditional six-step planning process (aka, the "beehive") and the USACE risk management framework. Just as Planning has always been about solving problems and making decisions under uncertainty, risk management is a decision making framework for making decisions under uncertainty. Risk-informed planning provides tools to efficiently reduce uncertainty by gathering only the evidence needed to make the next planning decision and to manage the risks that result from doing so without more complete information. Figure 6 below shows the blending of the six-step planning process and risk management framework to constitute Risk Informed Planning.

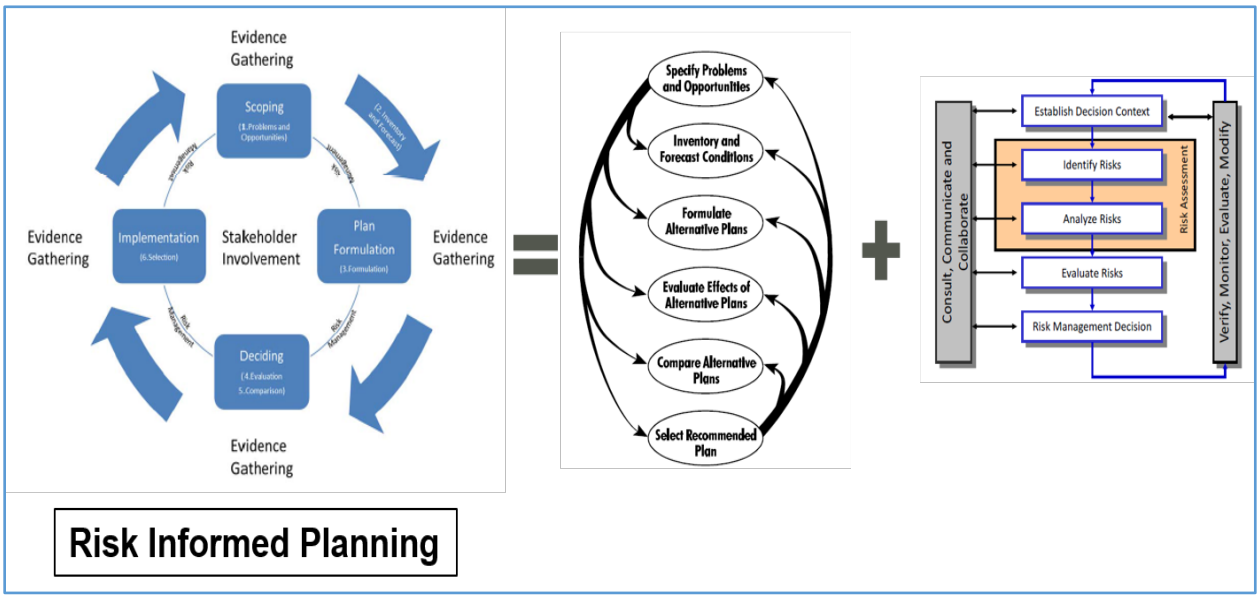

Figure 6. Risk Informed Planning

What are these risk informed planning tools, who develops them, and when? The *Planning Manual Part II: Risk-Informed Planning* offers many examples and tools of risk informed planning, some of which are highlighted in this Handbook: conducting several rapid iterations of the planning process as the study progresses; developing the six pieces of paper as part of scoping the study; conducting charette(s) to perform a rapid iteration(s); thinking about problem identification as "Risk Identification;" developing a risk register to identify study, implementation, and outcome risks, as well as options to manage those risks; thinking about the future without project condition as multiple future scenarios, and realizing that the level of detail associated with the FWOP will evolve as the study progresses; developing plan formulation strategies to think about various ways to tackle problems and meet planning objectives; identifying decision criteria of varying specificity and level of detail to be used for initial screening through evaluation of alternatives to optimizing the TSP; and a risk assessment of the TSP. These tools are usually developed collectively by PDT members throughout the feasibility study process, from the very first scoping meeting to the selection of the TSP and recommended plan.

Advantages. The chief advantage Risk Informed Planning or Risk Informed Decision-Making (RIDM) is to efficiently reduce uncertainty by gathering only the evidence needed to make the next planning decision and to manage the risks that result from doing so without more complete information. This allows studies to make progress from Day One, to streamline and economize data collection by using existing information and expertise to the greatest extent practicable, to advance even under time and budget constraints (through risk management), and to disclose to decision-makers and stakeholders, as well as proactively manage, implementation and outcome risks.

Examples. Many planners ask how Risk Informed Planning or RIDM plays out in feasibility studies. The easiest way to demonstrate what RIDM means for various business lines is simply to offer examples. Reducing uncertainty and instrumental risk for a FRM study may be achieved by the decision to spend significant time and money to gather geotechnical borings prior to screening the final array of alternatives and deciding on the TSP. Conversely, an Aquatic Ecosystem Restoration (AER) study may reduce instrumental risk and uncertainty very little after spending the time and money on geotechnical borings, and the RIDM process would lead the PDT to conclude that borings-related data is not necessary to make the TSP selection. Data gathering and analysis on sediment transport in a stream may be far more valuable for the AER study in reducing instrumental risk and uncertainty. For any study where data gathering and analysis is considered, part of RIDM includes the scale of data gathering analysis, and determining how much is needed to make a decision, even though that may be far less detail than needed for Preconstruction Engineering and Design of the recommended plan.

In terms of examples from specific studies, planners may ask what risk identification looked like, or how was the qualitative risk assessment of the TSP conducted? Examples of how RIDM was applied to both an AER project (St. Louis Riverfront - Meramec River Basin Ecosystem Restoration Feasibility Study, Missouri) and a coastal storm risk management study (Florida Keys Coastal Storm Risk Management Feasibility Study, Florida) are summarized in the following PowerPoint presentations.

Skaggs RIDM for AER Mentors KC Aug 2019

Skaggs PA 2019 CSRM Course Risk Pla

Conclusion: The *Planning Manual Part II: Risk-Informed Planning* offers many excellent "generic" examples and tools to conduct risk informed planning and RIDM. Planners and mentors should consult the Planning Manual Part II on a frequent basis. In addition to the two examples cited above, as specific examples of how RIDM has been successfully applied to various business lines or project purposes unfold across USACE, they can be added to this Handbook, presented as webinars, and offered as case studies in training courses.

Topic 9: TSP Risk Assessment

What is it? The TSP Risk Assessment is a tool that will help teams better understand their TSP and potentially help identify risks that should be managed as the study moves into PED, construction, and monitoring. According to the *Planning Manual Part II: Risk-Informed Planning, Section 10.4*, *"Following their choice of a TSP, the PDT should conduct at least a qualitative risk assessment of this plan in order to identify the residual risk that remains with the plan, if they were not included among the decision criteria, and to identify any new, transformed, or transferred risks generated by the new plan."*

Also, Planning Bulleting (PB) 2019-04, *Incorporating Life Safety into Flood and Coastal Storm Risk Management Studies*, requires that for flood and coastal risk management studies a risk assessment be performed to evaluate life safety risks and the tolerability of any proposed dams, levees, or floodwalls. For those studies, greater coordination with their respective PCX and possibly the Risk Management Center (RMC), Dam Safety Modification MCX, or Levee Safety Center will be needed to identify the right level of detail.

For many studies, a qualitative risk assessment is probably sufficient to identify most risks, but particularly for flood and coastal risk management studies, some form of semi-quantitative or quantitative risk assessment may be more appropriate. This discussion focuses more generally on the TSP Risk Assessment, and not the specifics of PB 2019-04.

Who develops it and when is it developed? The TSP Risk Assessment should be developed after the TSP milestone meeting. The PDT should develop the risk assessment and also seek input from those who have been outside the process and may not have been influenced by any biases developed by the team over time.

One tip to developing the risk assessment is to use "Inverse Brainstorming". Inverse brainstorming allows people to unleash the destructive energy we all hold back in ourselves. The concept is fairly simple – start with assuming that your TSP is satisfactory. Then start nitpicking it. Ask yourselves "What can go wrong?", "What could prevent us from achieving our benefits?", "Does our plan create new hazards or transfer existing ones to another area?"

The PDT is looking to both understand what the residual risks of the TSP are (i.e., the risk that remains after we implement the TSP) and what are the things that could prevent us from realizing the benefits of the TSP.

Advantages. The TSP Risk Assessment can help PDTs identify any "loose ends" they may need to clean up before a final report, but it will ideally serve as the primer for risk management as the study progresses into PED, providing a solid foundation for understanding the past and future risks associated with the project.

Examples. The St. Louis Riverfront - Meramec River Basin Ecosystem Restoration Feasibility Study, Missouri, completed in July 2019, included a qualitative risk assessment of the TSP to identify the residual risk that remains with the plan. The PDT identified both 1) *implementation risks* (i.e., what can affect the efficacy, quality, timing, and budget of the built project?); and 2) *outcome risks* (i.e., what are the residual, new, transferred or transformed risks attributable to the recommended plan?). Two implementation risks were identified. 1) Potential CERCLA

liability could result in unexpected clean-up costs or litigation (identified as a “medium” risk driven by low likelihood and high consequences). To mitigate for this risk, the PDT recommended continuing and consistently collaborating with USEPA, and that soils at the project sites would be tested for contaminants during PED. 2) Specific restoration sites could change during the PED phase (identified as a “medium” risk driven by high likelihood and low consequences). To mitigate for this risk, the PDT performed a sensitivity analysis on potential site location shifts and reduced scale scenarios to show continued Federal interest and that overall ecological benefits were not highly dependent on the exact location of sites. One outcome risk was identified, namely that constructed habitat restoration features could change during high river flows (identified as a “medium” risk driven by low likelihood and high consequences). To mitigate for this risk, the PDT followed the designs and monitored similar USEPA Pilot Project sites, and developed a robust adaptive management plan.

See the complete “St. Louis Riverfront - Meramec River Basin Ecosystem Restoration Feasibility Study, Missouri,” July 2019, for more details on the qualitative risk assessment conducted on the TSP and recommended plan: https://www.mvs.usace.army.mil/Portals/54/docs/pm/Reports/FS/MeramecFSFinalReport.pdf?ver=2020-01-03-092246-990

For reference, an example summarizing the qualitative risk assessment performed to evaluate life safety risks associated with a flood risk management study, as required by Planning Bulleting (PB) 2019-04, for the Lower Mud River Flood Risk Management Project, West Virginia, Validation Study (July 2019) is provided below.

Lower Mud River
FRM Risk Assessment

Conclusion: The TSP Risk Assessment is a tool that helps the broader life-cycle management of a project and takes advantage of the expertise the team has developed throughout the study, captures their concerns, and provides a solid foundation at managing risk as the study progress from planning, to PED, and through construction.